



आईएफटीएम विश्वविद्यालय, मुरादाबाद, उत्तर प्रदेश
IFTM University, Moradabad, Uttar Pradesh
NAAC ACCREDITED

SCHOOL OF SCIENCES
DEPARTMENT OF BOTANY

MASTER OF SCIENCE (BOTANY)

TWO YEAR PROGRAMME

[W. E. F. ACADEMIC SESSION: 2020 - 21]

IFTM UNIVERSITY
N.H.-24, Lodhipur Rajput, Delhi Road, Moradabad, Uttar Pradesh-244001
www.iftmuniversity.ac.in



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**SCHOOL OF SCIENCES
DEPARTMENT OF BOTANY**

**Study & Evaluation Scheme of
Master of Science (Botany)
[Session 2020-21]**

Programme	: Master of Science (Botany)
Course Level	: PG Course
Duration	: Two Year (Four Semester) Full Time
Medium of Instruction	: English
Minimum Required Attendance	: 75%
Maximum Credits	: 80

Programme Outcomes (POs):

Students completing this course will be able to:

- To understand the different field of Botany such as lower and higher plants, plants systematics, biodiversity and conservation, plant physiology, biochemistry, anatomy, reproduction in plants, genetics, cell and molecular biology of various forms of plants.
- Enhance the understanding about the diversity of micro-organisms, their classification, structure and growth. Develop theoretical and technical skills of basic microbiology (sterilization, isolation, culture, preservation of microbes).
- Identify various life forms of plants, their interaction with the environment and vice-versa.
- Understand the economic and other social importance of plants and plant products.
- Know how to develop the plant species by using various techniques of plant breeding.
- Think logically and organize tasks into a structured form.
- Analyze data using appropriate statistical methods and computer packages

Course structure of M. Sc. (Botany)-I Year (I Semester)

S. No.	Subject Code	Subject Title	Periods			Evaluation Scheme				Total	Credit
						Internal Exam			External Exam		
			L	T	P	MSE	AS+AT	Total			
THEORY											
1.	MBO-101	VIRUSES, BACTERIA AND FUNGI	3	1	0	10+10	5+5	30	70	100	4
2.	MBO-102	ALGAE AND BRYOPHYTES	3	1	0	10+10	5+5	30	70	100	4
3.	MBO-103	CYTOLOGY AND GENETICS	3	1	0	10+10	5+5	30	70	100	4
4.	MBO-104	CELL AND MOLECULAR BIOLOGY	3	1	0	10+10	5+5	30	70	100	4
PRACTICALS / PROJECT											
5.	MBO-151	LOWER AND HIGHER PLANTS	-	-	4	-	-	30	70	100	2
6.	MBO-152	CYTOLOGY & GENETICS	-	-	4	-	-	30	70	100	2
		TOTAL	12	04	8	-	-	-	-	600	20

Course structure of M. Sc. (Botany)-I Year (II Semester)

S. No.	Subject Code	Subject Title	Periods			Evaluation Scheme				Total	Credit
						Internal Exam			External Exam		
			L	T	P	MSE	AS+AT	Total			
THEORY											
1.	MBO-201	PTERIDOPHYTES, GYMNOSPERMS AND PALAEOBOTANY	3	1	0	10+10	5+5	30	70	100	4
2.	MBO-202	TAXONOMY OF ANGIOSPERMS	3	1	0	10+10	5+5	30	70	100	4
3.	MBO-203	PLANT PHYSIOLOGY	3	1	0	10+10	5+5	30	70	100	4
4.	MBO-204	PLANT BIOCHEMISTRY	3	1	0	10+10	5+5	30	70	100	4
PRACTICALS / PROJECT											
5.	MBO-251	VASCULAR PLANTS AND TAXONOMY OF ANGIOSPERMS	-	-	4	-	-	30	70	100	2
6.	MBO-252	PLANT PHYSIOLOGY AND BIOCHEMISTRY	-	-	4	-	-	30	70	100	2
		TOTAL	12	04	8	-	-	-	-	600	20

Course structure of M. Sc. (Botany) -II Year (III Semester)

S. No.	Subject Code	Subject Title	Periods			Evaluation Scheme				Total	Credit
						Internal Exam			External Exam		
			L	T	P	MSE	AS+AT	Total			
THEORY											
1.	MBO-301	EMBRYOLOGY AND ANATOMY OF ANGIOSPERMS	3	1	0	10+10	5+5	30	70	100	4
2.	MBO-302	PLANT PATHOLOGY	3	1	0	10+10	5+5	30	70	100	4
3.	MBO-303	PLANT BREEDING AND BIOSTATISTICS	3	1	0	10+10	5+5	30	70	100	4
4.	MBO-304	PLANT RESOURCES AND UTILIZATION	3	1	0	10+10	5+5	30	70	100	4
PRACTICALS / PROJECT											
5.	MBO-351	EMBRYOLOGY, ANATOMY AND PLANT PATHOLOGY	-	-	4	-	-	30	70	100	2
6.	MBO-352	PLANT BREEDING, BIOSTATISTICS AND ECONOMIC BOTANY	-	-	4	-	-	30	70	100	2
		TOTAL	12	04	8					600	20

Course structure of M. Sc. (Botany)-II Year (IV Semester)

S. No.	Subject Code	Subject Title	Periods			Evaluation Scheme				Total	Credit
						Internal Exam			External Exam		
			L	T	P	MSE	AS+AT	Total			
THEORY											
1.	MBO-401	BIODIVERSITY CONSERVATION AND ENVIRONMENTAL MANAGEMENT	3	1	0	10+10	5+5	30	70	100	4
2.	MBO-402	PLANT ECOLOGY	3	1	0	10+10	5+5	30	70	100	4
3.	MBO-403	PLANT BIOTECHNOLOGY	3	1	0	10+10	5+5	30	70	100	4
PRACTICALS / PROJECT											
4.	MBO-451	PLANT ECOLOGY AND BIO TECHNOLOGY	-	-	4	-	-	30	70	100	2
5.	MBO-452	DISSERTATION	-	-	4	-	-	-	-	200	6
		TOTAL	9	03	8	-	-	-	-	600	20

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-I Year (I Semester)

MBO-101: VIRUSES, BACTERIA AND FUNGI

Objective: The objective of this course to enhance the knowledge of the students about viruses, bacteria and fungi, their classification, structure, growth and their economic importance.

Unit – I

(08 Sessions)

Viruses: General characteristic, structure and mode of replication in viruses, Bacteriophage T4, lambda phage. General characters and importance of viroids, virusoids, prions.

Unit – II

(08 Sessions)

Bacteria: Characteristics of archaebacteria and eubacteria, Gram positive and Gram negative bacterial cell wall, Mode of nutrition, Asexual Reproduction and Genetic recombination (Transformation, Transduction & Conjugation), economic importance of bacteria.

Cyanobacteria: structure, reproduction and importance.

Mycoplasma: general characters, structure, reproduction and diseases.

Unit – III

(08 Sessions)

Classification of Fungi proposed by Alexopoulos, Mims and Blackwell (1996).

General characters of fungi, cell structure and nutrition, thallus organization in fungi.

Types of reproduction in fungi, nutrition and growth in fungi including factors affecting fungal growth.

Heterothallism, Heterokaryosis, Parasexuality and Physiological specialization in fungi.

Unit – IV

(10 Sessions)

A general account and affinities of the following groups with special reference to systematic position, structure and reproduction of organisms mentioned here under:

A. The Fungi belonging to Kingdom Protozoa.

Phylum Myxomycota

Class- Myxomycetes- *Stemonites*, *Physarum*

Phylum- Plasmodiophoromycota

Class- Plasmodiophoromycetes- *Plasmodiophora*

B. The Fungi belonging to Kingdom Chromista.

Phylum- Oomycota

Class-Oomycetes: *Saprolegnia*, *Pythium*, *Phytophthora*

C. The fungi belonging to Kingdom Fungi

Phylum-Chytridiomycota

Class- Chytridiomycetes- *Allomyces*

Phylum Zygomycota

Class-Zygomycetes- *Pilobolus*, *Mucor*, *Rhizopus* Phylum –Ascomycota

Class-Ascomycetes- *Erysiphae*, *Peziza*, *Neurospora*, *Penicillium*

Phylum Basidiomycota

Class-Basidiomycetes: *Rocella*, Class- Amastigomycota- *Puccinia*, *Uromyces*

Phylum Deuteromycota / Fungi imperfecti (Anamorphic Fungi/ Asexual fungi): *Penicillium*, *Cercospora*, *Helminthosporium*, *Fusarium*, *Aspergillus*, *Colletotrichum*

Unit – V

(08 Sessions)

Mycorrhizae, Lichens (Structure, types, reproduction and importance), Economic importance of fungi.

Course Outcomes:

Students completing this course will able to:

- Understand the diversity of micro-organisms such as viruses, bacteria, fungi lichens, their classification, structure and growth.

- Increase the understanding the economic values of bacteria, fungi, mycorrhizae, lichens and develop theoretical & technical skills about them.

Suggested Readings:

1. Pelczar M.J., Chan E.C.S and Kreig N.R. (1997). Microbiology Tata MacGraw Hill.
2. Plant Virology (2014) by Roger Hull; Elsevier/Academic Press, fifth edition, ISBN: 9780123848710
3. Willey, J M., Sherwood, L.M. and Woolverton, C.J. (2017). Prescott's Microbiology, 10th Edition, McGraw-Hill, USA
4. Ingraham R. Y., Wheels J.L. and Painter M.L. (1976). General Microbiology. The Macmillan
5. The Biology of Mushroom... by Steven L. Stephenson
6. Mehrotra, R. S. and Aneja, R.S. 1998. An introduction to Mycology, New age, intermediate press.
7. Fungi - Kingdom Fungi Vermeulen,
8. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology (4th ed.), John Wiley & Sons.
9. Webster J, Weber R, Introduction to Fungi, Cambridge University Press
10. Michael J Carlile, Dr, Sarah C Watkinson and Graham W Gooday The Fungi (Second Edition)
11. Vashishta B.R. (1990) Botany for Degree Students Part-II Fungi, S. Chand & Co. New Delhi.
12. Dubey H.C. (1990): An Introduction to Fungi Vikas Publishing House, New Delhi

Website Sources:

- www.kopykitab.com
- www.pdfdrive.com/botany-books.html
- www.digitalbookindex.org
- [cqej.altopianoblu.it > botany-notes-pdf](http://cqej.altopianoblu.it/botany-notes-pdf)
- www.kalyanipublication.co.in
- www1.biologie.uni-hamburg.de
- [www.topfreebooks.org >](http://www.topfreebooks.org)
- www.pdf.com
- en.wikipedia.org
- onlineecourses.nptel.ac.in
- www.yourarticlelibrary.com
- www.freebookcentre.net

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-I Year (I Semester)

MBO-102: ALGAE AND BRYOPHYTES

Objective: The course aims to have the understanding of classification, diversity, vegetative growth, reproduction methods algae and amphibians of plant kingdom (bryophytes), Another objective of this course is to understand their evolution, distribution, economic and ecological importance of these plants.

Unit-I **(08 Session)**

Algae: Classification of algae according to Fritsch and salient features of different classes of Algae.
Algal pigments, food reserves, flagellation and their importance in classification.

Unit – II **(08 Session)**

Thallus organization in algae, reproduction and life cycle and alteration of generations.
Economic importance of algae as food, feed, source of chemicals and drugs, Algal biofertilizers, uses in industry, Algal blooms.

Unit-III **(10 Session)**

Comparative study of classes of Chlorophyceae (*Pandorina*, *Chlorella*, *Hydradictyon*, *Ulva*, *Fritschiella*, *Zygnema*, *Closterium* and *Caulerpa*), Xanthophyceae (*Botrydium* and *Codium*) and Bacillariophyceae (*Pinnularia*, *Navicola*), with reference to range of structure of plant body including ultrastructure, Methods of reproduction, Variation in life cycles.

Comparative study of Phaeophyceae (*Ectocarpus*, *Laminaria*, *Fucus*) and Rhodophyceae (*Porphyra*, *Batrachospermum*) with reference to range of structure of plant body, Range of mode of reproduction, Variation in life cycles.

Unit-IV **(10 Session)**

Bryophytes: General characters and classification with special reference to Rothmaler.
Structure and Reproduction of Marchantiales (*Targionia*, *Plagiochasma*), Jungermaniales (*Porella*), Anthocerotales (*Anthoceros*), Sphagnales (*Sphagnum*) and Polytrichales (*Polytrichum*).

Unit-V **(06 Session)**

Evolution of Sporophyte in Bryophyte, Comparative study of Bryophytes.
Economic and Ecological importance of Bryophytes.

Course Outcomes:

Students completing this will be able to:

- Understand the diversity of algae, their life cycle patterns and evolution of bryophytes.
- Have the knowledge of economic and ecological significance of both plant groups.
- It will help to understand the comparison between algae and bryophytes.

Suggested readings:

1. Andersen RA (2005). Algal Culturing Techniques. Physiological Society of America. Elsevier Academic Press, USA.
2. Cole KM and Sheath RG (1990). Biology of the Red Algae. Cambridge Univ. Press, Cambridge.
3. Fritsch FE (1945). The Structure and Reproduction of Algae. Vol. II. Cambridge Univ. Press. Cambridge, London.
4. Lee RE (1989). Phycology. Vol. II. Cambridge Univ. Press. Cambridge, USA.
5. South GR and Whittick A. (1987). Introduction to Phycology. Blackwell Scientific Publications. London.
6. Morris. I. 1986. An introduction to the algae, Cambridge university press, u.k.
7. Kumar, H.D. 1988. Introductory Phycology. Affiliated East – West press Ltd., New Delhi

8. Parihar, N.S. 1991. Bryophyta. Central Book Depot, Allahabad
9. Puri, P. 1980. Bryophytes. Atma Ram & Sons, Delhi
10. Pandey B.P. (2000) College Botany Vol-I (Algae, Fungi, Bryophytes) S. Chand & Co. New Delhi.
11. Vashishta, B.R. Text Book of Algae. New Delhi

Website Sources:

- www.kopykitab.com
- www.pdfdrive.com/botany-books.html
- www.digitalbookindex.org
- [cqej.altopianoblu.it > botany-notes-pdf](http://cqej.altopianoblu.it/botany-notes-pdf)
- www.kalyanipublication.co.in
- www1.biologie.uni-hamburg.de
- [www.topfreebooks.org >](http://www.topfreebooks.org)
- www.pdf.com
- en.wikipedia.org
- onlinecourses.nptel.ac.in
- www.yourarticlelibrary.com
- www.freebookcentre.net
- <https://www.easybiologyclass.com>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-I Year (I Semester)

MBO-103: CYTOLOGY AND GENETICS

Objective: This course aims to introduce the students with the different types of microscopes and their uses. The students will also learn about the structure of chromosomes, packaging of DNA, types of special chromosomes, Mendelian inheritance, gene interaction, genetic recombination in bacteria, and mutation in plant species as well as population genetics.

Unit – I **(10 Sessions)**

Microscopy: light microscope, resolving powers of different microscopes, microscopy of living cells, SEM, TEM, different fixation and staining techniques for electron microscope, AFM, STM
Chromatin Organization: Condensation and decondensation of chromatin, packaging of DNA in chromosome, euchromatin and heterochromatin, karyotype analysis, chromosomal banding, special types of chromosomes (polytene, lampbrush).

Unit – II **(10 Sessions)**

Mendelian principles, Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity.
Linkage and crossing over, sex linkage, sex limited and sex influenced characters.
Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes.

Unit – III **(07 Sessions)**

Genetic recombination in bacteria - transformation, conjugation and transduction, interrupted mating experiment for fine structural analysis.

Unit – IV **(07 Sessions)**

Mutation - Types, causes and detection, mutant types - lethal, conditional, biochemical, loss of function, gain of function, Transposons.
Structural and numerical alterations of chromosomes.

Unit – V **(08 Sessions)**

Population genetics – Populations, Gene pool, Gene frequency, Hardy-Weinberg Law, concepts and rate of change in gene frequency through natural selection, migration and random genetic drift.

Course Outcomes:

Students completing this will be able to:

- Understand the various types of microscopy like SEM, TEM, Light microscopy and their uses.
- Learn different fixation and staining techniques for electron microscope.
- Describe the chromosome types, structure, chromatin material, and packaging of DNA.
- Understand the mutation, causes of mutations and their impacts on agriculture crops.
- Course will also help to enhance the knowledge of students about Mendelian inheritance, gene interaction, crossing over, linkage and extra chromosomal inheritance.

Suggested Readings:

1. Acquaah G (2007). Principles of Plant Genetics and Breeding, Blackwell Publishing Ltd. USA.
2. Hartl DL and Jones EW (2007). Genetics – Analysis of Genes and Genomes, 7th edition, Jones and Barlett publishers.
3. Hartwell LH, Hood L, Goldberg ML, Reynolds AE, Silver LM, Veres RC (2006). Genetics – From Genes to Genomes, 3rd edition, McGraw Hill.
4. Lewin B (2008). Genes IX, Jones and Barlett Publishers.

5. Prasad Ganesh. Introduction to Cytogenetics. Kalyani Publication
6. Lodish H, Berk A, Kaiser CA and Krieger M. (2008) Molecular Cell Biology, 6th Edition, W.H. Freeman and Company, New York, USA.
7. Gupta, P.K. 1999. A text book of Cell and Molecular Biology. Rastogi Publications, Meerut, India.
8. Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetics. John Wiley and Sons, Inc. USA.
9. Russel, P.J. 1998. Genetics, The Benjamin/Cummings Publishing Co. Inc., USA.
10. P.M. Swamy: Essential Methods for Cell Biology
11. Singh R. J. (2002). Plant Cytogenetics, CRC Press

Website Sources:

- www.kopykitab.com
- www.pdfdrive.com/botany-books.html
- www.digitalbookindex.org
- [cqej.altopianoblu.it > botany-notes-pdf](http://cqej.altopianoblu.it/botany-notes-pdf)
- www.kalyanipublication.co.in
- www1.biologie.uni-hamburg.de
- [www.topfreebooks.org >](http://www.topfreebooks.org)
- www.pdf.com
- en.wikipedia.org
- onlineecourses.nptel.ac.in
- www.yourarticlelibrary.com
- www.freebookcentre.net
- <http://darwin.eeb.uconn.edu/>
- <https://www.researchgate.net/publication/>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-I Year (I Semester)

MBO-104: CELL AND MOLECULAR BIOLOGY

Objective: The objectives of this course are to expose the students to structure and functions of plant cell, biological membrane and cell organelles. Students will understand how these cellular components are used to generate and utilize energy in cells. This course also aims to enhance the knowledge on cell cycle, DNA replication, DNA damage and its repairing, and protein synthesis.

Unit-I **(08 Sessions)**

Plant cell wall: structure, biogenesis and expansion; Biological membranes with special emphasis on plasma membrane and tonoplast membrane structure and function.

Unit-II **(10 Sessions)**

Structural organization and function of intracellular organelles (nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility).

Cell cycle (steps in cell cycle, regulation and control of cell cycle), Mitosis, Meiosis.

Unit-III **(08 Sessions)**

DNA replication (enzymes involved, origin of replication and replication fork, models of DNA replication, fidelity of replication, extra chromosomal replicons); DNA damage and repair mechanisms.

Unit-IV **(10 Sessions)**

Transcription- RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, RNA splicing, structure and function of different types of RNA, RNA transport.

Unit-V **(08 Sessions)**

Translation – Ribosome & formation of initiation complex, elongation and termination. Translational proof-reading, translation inhibitors, Post- translational modification of proteins.

Control of gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing).

Course Outcomes:

Students who successfully complete this course will be able to:

- Understand the detailed account of the plant cell and biological membrane.
- Describe the Structures and functions of cell organelles
- Describe how RNA, DNA and proteins are synthesized.
- Explain the process of cell division in both somatic and germ cells.
- Describe cytological, biochemical, physiological and genetic aspects of the cell, including cellular processes common to all cells, to all eukaryotic cells as well as processes in certain specialized cells.
- Explain cellular processes and mechanisms that lead to physiological functions as well as examples of pathological state.
- Describe the intricate relationship between various cellular structures and their corresponding functions.
- Explain the process of DNA replication prokaryotes and eukaryotes, DNA damage and its repairing, and protein synthesis.

Suggested Readings:

1. Alberts B, Johnson A, Lewis J, Raff Martin, Roberts K and Walter P. (2007) Molecular Biology of the Cell. Garland Publ., New York.

2. Bonifacino JS, Dasso M, Harford JB, Liipincott-Schwartz J and Yamada KM. (2004) Short Protocols in Cell Biology. John Wiley & Sons, New Jersey.
3. Lodish H, Berk A, Kaiser CA and Krieger M. (2008) Molecular Cell Biology, 6th Edition, W.H. Freeman and Company, New York, USA.
4. Bregman AA (1987) Laboratory Investigations in Cell Biology. John Wiley & Sons, New York.
5. Hawes C and Satiat-Jeunemaitre B (2001) Plant Cell Biology: Practical Approach. Oxford University Press, Oxford.
6. Hirt RP and Horner DS (2004) Organelles, Genomes and Eukaryote Phylogeny: An evolutionary synthesis in the age of genomics. CRC Press.
7. Karp G. (2008) Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons.
8. Gupta, P.K. 1999. A text book of Cell and Molecular Biology. Rastogi Publications, Meerut, India.
9. Rastogi, S.C. Cell and Molecular Biology
10. Verma, P.S. Cell biology, Genetics, Molecular Biology

Website Sources:

- <https://www.vedantu.com>
- <https://www.onlinebiologynotes.com>
- <https://www.khanacademy.orgwww.pdf.com>
- en.wikipedia.org
- www.freebookcentre.net
- <http://darwin.eeb.uconn.edu/>
- <https://www.researchgate.net/publication/>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-I Year (I Semester)

MBO-151: PRACTICAL (LOWER AND HIGHER PLANTS)

Objective: The course aims to share the knowledge to the students about the experiments. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations.

List of Practicals:

Microbiology: (06 Sessions)

- Cultivation of bacteria from different environmental samples
- Isolation of pure bacterial strains from mixed bacterial culture
- Grams staining of the isolated bacteria or curd sample
- Enumeration of population size of bacteria in water/ soil sample.

Fungi: (06 Sessions)

Study of thallus structures of different groups of fungi through preparation of whole mounts and sections. (*Stemonites, Physarum, Plasmodiophora, Saprolegnia, Pythium, Phytophthora, Allomyces, Pilobolus, Entomophthora, Erysiphae, Neurospora, Penicillium, Puccinia, Uromyces, Tilletia, Ustilago, Cercospora, Helminthosporium, Fusarium, Colletotrichum and others*)

Algae: (06 Sessions)

Study of thallus structures of different groups of algae through preparation of whole mounts and sections. (*Pandorina, Chlorella, Hydradictyon, Ulva, Fritschiella, Zygnema, Closterium, Caulerpa, Botrydium, Codium, Pinnularia, Ectocarpus, Laminaria, Fucus, Porphyra, Batrachospermum and others*)

Bryophytes: (06 Sessions)

Study of morphology, anatomy and reproductive structures of bryophytes. (*Targionia, Plasiochasma, Porella, Anthoceros, Sphagnum, Polytrichum and others*)

Course Outcomes:

Completing this course, students will be able to:

- Culture the different bacterial strains and isolate them from environmental conditions.
- Have the knowledge of Gram staining technique.
- Gain knowledge on fixation, dehydration, hand sectioning, microtome sectioning.
- Observe and identify the microbes, algae and fungi.

Suggested Readings:

1. Morris. I. 1986. An introduction to the algae, Cambridge university press, u.k.
2. Kumar, H.D. 1988. Introductory Phycology. Affiliated East – West press ltd., New Delhi
3. Parihar, N.S. 1991. Bryophyta. Central Book Depot, Allahabad
4. Puri, P. 1980. Bryophytes. Atma Ram & Sons, Delhi
5. Pandey B.P. (2000) College Botany Vol-I (Algae, Fungi, Bryophytes) S. Chand & Co. New Delhi.
6. Vashishta, B.R. Text Book of Algae. New Delhi
7. Botany Practical Vol. I by B.P. Pandey
8. A text Book of Practical Botany 1 by Bendre and Kumar
9. Practical Botany II by O.P. Sharma

Website Sources:

- <https://oer.galileo.usg.edu>
- <http://www.biologycorner.com>
- <https://www.vedantu.com>
- <https://www.onlinebiologynotes.com>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-I Year (I Semester)

MBO-152: PRACTICAL (CYTOLOGY AND GENETICS)

Objective: The course aims to share the knowledge to the students about the experiments. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations.

List of Practicals:

(16 Sessions)

1. Preparation of mitotic spreads and analysis of various stages of cell division (*Allium*).
2. Preparation of meiosis spreads and analysis of various stages of cell division (*Allium / Phlox*).
3. Isolation of plant DNA and its quantitation by a spectrophotometric method.
4. Separation of plant DNA by agarose gel electrophoresis and visualization by ethidium bromide staining.
5. Cell Separation, Cell counting,
6. Karyotype analysis.
7. Problems related to Mendelian experiments.

Course Outcomes:

Completing this course, students will be able to:

- Prepare permanent slides and identify various stages of cell division in somatic cell and germ cell with the help of onion root tip/ flower buds.
- Isolate and separate plant DNA material.
- learn about karyotype analysis and solve the problems related to Mendelian experiments.

Suggested Readings:

1. Practical Botany II by O.P Sharma
2. A text Book of Practical Botany2 by Bendre and Kumar
3. Modern Practical Botany Vol. III by B.P. Pandey
4. Karp G. (2008) Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons.
5. Gupta, P.K. 1999. A text book of Cell and Molelcular Biology. Rastogi Publications,Meerut, India.

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M. Sc. (Botany)-I Year (II Semester)

MBO-201: PTERIDOPHYTES, GYMNOSPERMS AND PALAEOBOTANY

Objective: This course aims to enhance the knowledge of the students in terms of distribution, morphology and anatomy of pteridophytes and gymnosperms. The specific objectives of this course are to study heterospory, seed habits and stellar evolution in pteridophytes, economic importance of pteridophytes and gymnosperms, and general account of palaeobotany.

Unit-I **(08 Sessions)**

Classification of Pteridophytes with special reference to Sporne, Evolution of stele
Heterospory and origin of seed habit.

Unit – II **(10 Sessions)**

Structure and reproduction of *Psilopsida* (*Psilotum*, *Rhynia*, *Horneophyton*, *Asteroxylon*), *Lycopsidea* (*Isoetes*, *Lepdodendron*), *Sphenopsida* (*Calamitis*, *Sphenophyllum*) and *Pteropsida* (*Ophioglossum*, *Osmunda*, *Gleichenia*, *Adiantum*, *Azolla*, *Salvinia*)
Economic importance of Pteridophytes.

Unit – III **(08 Sessions)**

Introduction of Gymnosperms, classification with special reference to Sporne (1965).
Distribution of gymnosperms in India, Affinities with Pteridophytes and Angiosperms.

Unit-IV **(10 Sessions)**

Study of morphology, anatomy and life history of the following genera:

A. Cycadopsida: Pteridospermales: A general account with special reference to Bennettitales (*Williamsonia*) and Pentoxylales (*Pentoxylon*).

B. Coniferopsida: Coniferales (*Pinus*, *Araucaria* & *Cephalotaxus*), Taxales (*Taxus*), Ginkgoales (*Ginkgo*).

C. Gnetopsida: Gnetales (*Gnetum*).

Unit – V **(08 Sessions)**

Origin and evolution of gymnosperms, Economic importance of gymnosperms
Palaeobotany: Fossils, Fossilization and geological time-scale, Study of some fossil seed Plants

Course Outcomes:

Completing this course, students will be able to:

- Describe the morphology and anatomy of the vascular cryptogams and gymnosperms.
- Have understanding on evolution and affinities of these plants groups.
- Enhance their knowledge about the economic and ecological importance of these plants.
- Study about the fossils, geological time scale etc.

Suggested readings:

1. Parihar, N.S. 1996. Biology and Morphology of Pteridophytes. Central Booki Depot, Allahbad
2. Sporne, K. K. 1991. The Morphology of pteridophytes. B.I. Publishing Pvt. Ltd., Bombay.
3. Stewart, W.N. and Rathwell, G.W. 1993. Paleobotany and the evolution of plants. Cambridge University Press
4. Bhatnagar SP and Moitra A (2005) Gymnosperms. New Age Interactive (P) Ltd. Publishers, New Delhi.
5. Vashistha, P. C. A text book of Gymnosperm. S. Chand Publication, New Delhi.

Website Sources:

- www.pdfdrive.com/botany-books.html
- www.digitalbookindex.org

- www1.biologie.uni-hamburg.de
- www.topfreebooks.org ›
- www.pdf.com
- en.wikipedia.org
- onlinecourses.nptel.ac.in
- www.yourarticlelibrary.com
- www.freebookcentre.net

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-I Year (II Semester)

MBO-202: TAXONOMY OF ANGIOSPERMS

Objective: The objective of this course is to enhance the knowledge of the students about the flowering plants, their classification, and nomenclature. This course also aims to study the role of BSI, Herbarium, Botanical gardens in modern plant taxonomy.

Unit – I

(08 Sessions)

International Code of Botanical Nomenclature (ICBN), Binomial nomenclature, Botanical Survey of India (BSI), Herbarium and its role in modern plant taxonomy, Botanical Gardens and Herbaria.

Taxonomic evidences: Morphology, Plant anatomy, Palynology, Embryology, Cytology, Phytochemistry in relation to taxonomy, numerical taxonomy, Serotaxonomy. Molecular Phylogeny & taxonomy

Unit- II

(08 Sessions)

Concept of Taxa and Taxonomic Hierarchy: Taxonomic categories, concept of species, genus, family and order, Origin of Angiosperms.

Systems of classification: Bentham & Hooker (in detail), Outline of Engler and Prantl, Hutchinson, Cronquist and Takhtajan.

Unit- III

(10 Sessions)

Description of some Dicotyledons classes.

Polypetalae with special reference to Ranunculaceae, Magnoliaceae, Papaveraceae, Nymphaeaceae, Capparidaceae, Moraceae, Cactaceae, Myrtaceae, Apiaceae and Cucurbitaceae.

Unit- IV

(10 Sessions)

Gamopetalae with special reference to Rubiaceae, Bignoniaceae, Apocynaceae, Asteraceae and Verbenaceae.

Monochamydeae with special reference to Nyctaginaceae, Amaranthaceae, Polygonaceae, Lauraceae and Euphorbiaceae.

Unit- V

(08 Sessions)

Description of some Monocotyledons.

Microspermae: Orchidaceae

Epigynae: Amaryllidaceae

Coronarieae: Commelinaceae

Calycinae: Arecaceae (Palmae)

Nudiflorae: Aroideae (Araceae)

Glumaceae: Cyperaceae and Poaceae

Course Outcomes:

Students completing this course will learn:

- What is the role of ICBN in plant taxonomy? what are different data sources in systematics?
- What are different methods of naming plants? What are different principles of nomenclature? Why name changes?
- What are artificial, natural and phylogenetic systems of classification?
- What are different methods of collecting and preserving plants? What is the importance of maintaining plants in botanic gardens?
- Comparison among different flowering plants groups.

Suggested Readings:

1. Angiosperm Phylogeny Group (2003) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. Botanical Journal of the Linnaean Society 141: 399-436.

2. Cracknell AP, Hayes L (2009) Introduction to Remote Sensing. CRC Press, Boca Raton, USA (Special Indian Edition)
3. Crawford DJ (2003) Plant Molecular Systematics. Cambridge University Press, Cambridge, UK.
4. Cronquist A (1981). An integrated system of classification of flowering plants. Columbia University Press, New York.
5. Hollingsworth PM, Bateman RM and Gornall RJ (1999). Molecular systematics and Plant Evolution. Taylor and Francis, London.
6. Judd WS, Campbell CS, Kellogg EA, Stevens PA and Donoghue MJ (2002) Plant Systematics: A Phylogenetic Approach. Sinauer Associates, Inc., Massachusetts.
7. Nei M and Kumar S (2000) Molecular Evolution and Phylogenetics. Oxford University Press, New York.
8. Raven PH, Begr LR, Hassenzahl DM (2008) Environment. 6th edition. John Wiley & Sons, Inc., New York.
9. Semple C and Steel MA (2003) Phylogenetics. Oxford University Press, Oxford.
10. Simpson MG (2006) Plant Systematics. Elsevier, Amsterdam.
11. Stuessy TF (2008) Plant Taxonomy: The systematic Evaluation of Comparative Data. Columbia University Press, New York.
12. Swafford DL (2001) PAUP*. Phylogenetic analysis using parsimony (* and other methods), version 4. Sinauer Associates, Sunderland.
13. Sharma, O.P. 1996. Hill's Economic botany (A. F. Hill adapted by O.P. Sharma) Tata Mc Graw hill Co. New Delhi.

Website Sources:

- <http://www.equisetites.de>
- <https://www.science.gov>
- www.pdfdrive.com/botany-books.html
- www.digitalbookindex.org
- [cqej.altopianoblu.it › botany-notes-pdf](http://cqej.altopianoblu.it/botany-notes-pdf)
- www.kalyanipublication.co.in
- www1.biologie.uni-hamburg.de
- [www.topfreebooks.org ›](http://www.topfreebooks.org)
- www.pdf.com
- en.wikipedia.org
- onlinecourses.nptel.ac.in
- www.yourarticlelibrary.com
- www.freebookcentre.net
- www.nativeplants.org

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-I Year (II Semester)

MBO-203: PLANT PHYSIOLOGY

Objective: The course will deal with advance topics on plant growth and development, plant growth hormones, their roles and stress physiology.

Unit – I **(08 Sessions)**

Absorption of water: Mechanism of water absorption; Active and Passive water absorption; Ascent of Sap, Transpiration and its significance, Mechanism of opening and closing of stomata; Guttation; Translocation of solute (Organic and Inorganic).

Unit – II **(10 Sessions)**

Photosynthesis: photosynthetic apparatus; photosynthetic pigments and light harvesting complexes; Photo oxidation of water; Mechanism of electron transport system, Carbon assimilation-the Calvin Cycle; Photorespiration and its significance, C₄ Plants, the CAM pathway.

Unit – III **(10 Sessions)**

Respiration: Mechanism of respiration-Glycolysis, aerobic oxidation of Pyruvic acid (Krebs Cycle), Electron Transport Chain, Fermentation, Respiratory Quotient (RQ) and factors affecting the rate of respiration. Mineral Nutrition in Plants: General role of mineral elements in plants; important symptoms of deficiency of mineral elements; Nitrogen Metabolism: biological nitrogen fixation, mechanism of nitrate uptake and reduction, ammonia assimilation.

Unit-IV **(10 Sessions)**

Course of growth: measurement of growth, factors affecting the growth of plants. Growth hormones: Auxins, Gibberellins, Cytokinins, Ethylene, Absciscic Acid (ABA) and Morphactins. Photoperiodism and Photomorphogenesis: role of florigen and phytochrome in flowering. Vernalization: role of vernalin and gibberellins; Seed dormancy and germination.

Unit –V **(10 Sessions)**

Stress Physiology: Drought, Types of drought, morphological and cellular adaptations, mechanism of drought tolerance, drought tolerant crops, role of betaines, proline and other metabolites in stress resistance. Salinity stress: salt resistance, ion stress, mechanism of stress injury and resistance, Na⁺ and K⁺ ATPases and regulation of ion transport. Heat stress, Temperature stress and Heavy metal stress in plants; Phytoremediation.

Course Outcomes:

- This course will provide the better understanding of various physiological processes like absorption of water and minerals, photosynthesis, respiration, transpiration, seed germination and seed dormancy.
- This course will provide an understanding of nitrogen metabolism in plants.
- This course will help to understand the Phytohormones and their role in the development of plants.
- The students will be learning Abiotic stress signaling, stress tolerance/adaptive physiological and biochemical changes focusing on mechanisms. They should be in a position to extrapolate this knowledge for creating stress tolerance crops.
- Reactive oxygen species (ROS) and Reactive nitrogen species (RNS) are the main players. Students would be able to understand the biosynthesis of these redox species in biological systems as well as the antioxidative defense and significance of these in various physiological functions.
- The students will also learn various osmolytes or metabolites and their role in stress physiology
- The students will also learn about various types of stress and defense mechanisms in plants.

Suggested Readings:

1. Hopkins, W. C. (1995): Introduction to Plant Physiology.
2. Krishnamurthy, H.N. (1992): Physiology of Plant Growth and Development.
3. Marschner, H. W. (1986): Mineral nutrition of Higher Plants.
4. Miller, P (1973) : Phytochemistry Vol.I, II and III.
5. Moore, T.C. (1974): Research experience in Plant Physiology, a laboratory manual.
6. Randhir Singh and Sawhney, S. K. (1988): Advances in frontier Areas of Plant Biochemistry.
7. Sadashivam and Manikam (1996): Plant Biochemical methods.
8. Taiz, L. and Ziegler, F. (1998): The Plant Physiology.
9. Pessarkli, M. (2004): Handbook of Plant and Crop Physiology, Marcel Dekkar Inc. NY.
10. Pessarkli, M. (2005): Handbook of Photosynthesis.

Website Sources:

- <https://www.science.gov>
- <https://library.um.edu.mo/>
- www.kopykitab.com
- www.pdfdrive.com/botany-books.html
- www.digitalbookindex.org
- ccej.altopianoblu.it › botany-notes-pdf
- www.kalyanipublication.co.in
- www1.biologie.uni-hamburg.de
- www.topfreebooks.org ›
- www.pdf.com
- en.wikipedia.org
- onlinecourses.nptel.ac.in
- www.yourarticlelibrary.com

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-I Year (II Semester)

MBO-204: PLANT BIOCHEMISTRY

Objective: This course aims to familiarize the students with structure of atoms, bonding, structure and function of biomolecules, energy synthesis during glycolysis, phosphorylation enzymes action, conformation of nucleic acids as well as metabolism of biomolecules.

Unit-I **(10 Sessions)**

Structure of atoms, molecules and chemical bonding, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).

Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interactions, etc).

Unit-II **(08 Sessions)**

Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).

Bioenergetics: glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.

Unit-III **(08 Sessions)**

Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes. Conformation of proteins (Ramachandran plot, secondary structure, tertiary and quaternary structure, domains, motif and folds).

Unit-IV **(08 Sessions)**

Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA). Stability of proteins and nucleic acids; Torsion Angles, Sugar Puckering.

Unit-V **(10 Sessions)**

Metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins.

Course Outcomes:

On completing this course , the students will be able to:

- Understand the structure of atoms, chemical bonding of molecules.
- Explain the structure and functions of biomolecules.
- Learn bioenergetics processes in plants.
- Understand the principles of enzymes, enzyme kinetics, enzyme regulation and mechanism of enzyme action.
- Students will also learn metabolism of biomolecules.

Suggested Readings:

1. Ainsworth C (2006) Flowering and its Manipulation, Annual Plant Reviews, Vol. 20. Blackwell Publishing, Oxford, U.K.
2. Brown TA. (2002) Genomes, BIOS Scientific Publishers Ltd, Oxford, UK.
3. Buchanan B, Gruissem G and Jones R. (2000) Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, USA.
4. Davies P J. (2004) Plant Hormones: Biosynthesis, Signal Transduction, Action. 3rd Edition, Kluwer Academic Publisher, Dordrecht, The Netherlands.
5. Jordan BR. (2006) The Molecular Biology and Biotechnology of Flowering, 2nd Edition, CAB International, Oxfordshire, U.K.
6. Lodish H, Berk A, Kaiser CA and Krieger M. (2008) Molecular Cell Biology, 6th Edition, W.H. Freeman and Company, New York, USA.
7. Nelson DL and Cox MM. (2004) Lehninger Principles of Biochemistry, 4th Edition, W.H. Freeman and Company, New York, USA.

8. Taiz L and Zeiger E. (2006) Plant Physiology, 4th Edition, Sinauer Associates Inc. Publishers, Massachusetts, USA.
9. Jain, J. L. A text book of Biochemistry, S. Chand Publication, New Delhi

Website Sources:

- <http://www.uky.edu/>
- <https://www.science.gov>
- <https://library.um.edu.mo/>
- www.digitalbookindex.org
- www1.biologie.uni-hamburg.de
- www.topfreebooks.org ›
- <https://sites.google.com/>
- www.pdfdrive.com/botany-books.html

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-I Year (II Semester)

MBO-251: PRACTICAL (VASCULAR PLANTS AND TAXONOMY OF ANGIOSPERMS)

Objective: The course aims to share the knowledge to the students about the experiments. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations.

List of Practicals: (32 Sessions)

Pteridophytes: Study of morphology, anatomy and reproductive structures of *Psilotum*, *Isoetes*, *Ophioglossum*, *Osmunda*, *Adiantum*, *Azolla* and *Salvinia*

Gymnosperm: Study of anatomy of vegetative and reproductive structures of: *Pinus*, *Araucaria*, *Cephalotaxus*, *Taxus*, *Ginkgo* & *Gnetum*.

Taxonomy of Angiosperm:

Detailed description and identification of locally available wild plants of the families:

Dicotyledons: Ranunculaceae, Magnoliaceae, Papaveraceae, Nymphaeaceae, Capparidaceae, Rutaceae, Moraceae, Myrtaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Bignoniaceae, Asteraceae, Apocynaceae and Verbenaceae. Nyctaginaceae, Polygonaceae, Lauraceae and Euphorbiaceae

Monocotyledons: Orchidaceae, Amaryllidaceae, Commelinaceae, Arecaceae (Palmae), Aroideae (Araceae), Cyperaceae and Poaceae.

Local flora study: Field trips within and around the campus and preparation of herbarium sheets of such plants, wild or cultivated; Botanical trip(s)

Course Outcomes:

Completing this course, students will be able to:

- Gain knowledge on fixation, dehydration, hand sectioning, microtome sectioning.
- Observe and identify the Pteridophytes, Gymnosperms and Flowering Plants.
- Develop the skill of collection and preservation of plant specimens.

Suggested Reading:

1. Practical Botany II by O.P Sharma
2. A text Book of Practical Botany2 by Bendre and Kumar
3. Modern Practical Botany Vol. III by B.P. Pandey
4. Modern Plant Taxonomy by N.S. Subrahmanyam
5. Plant Taxonomy by O.P. Sharma
6. Plant taxonomy. by Saxena and Saxena
7. Taxonomy of Angiosperms by Singh, Pandey and Jain

Website Sources:

- <https://oer.galileo.usg.edu>
- <http://www.biologycorner.com>
- www.pdfdrive.com/botany-books.html
- <https://library.um.edu.mo/>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-I Year (II Semester)

MBO-252: PRACTICAL (PLANT PHYSIOLOGY AND BIOCHEMISTRY)

Objective: The objective of this course is to share the knowledge to the students about the experiments. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations.

List of Experiments:

(24 Sessions)

1. Study of photosynthetic rate under different condition by using Wilmot's Bubblers.
2. Study of osmosis (exosmosis and endosmosis) by potato osmoscope.
3. Study of plasmolysis in *Tradescantia/Hydrilla* leaves.
4. Study of transpiration rate under different condition by using Ganong's/Farmer's Potometer.
5. Study of RQ of different respiratory substrates (carbohydrates, proteins, fats etc) by using Ganong's respirometer.
6. Find out the Rf values of amino acids in germinating seeds of any crop plant.
7. Preparation of the standard curve of protein (BSA) and estimation of the protein content in extracts of plant material by Lowry's method.
8. Qualitative and quantitative analysis of photosynthetic pigments and anthocyanins by spectrophotometric and chromatographic techniques.
9. To test the presence of starch in green leaf.
10. To test the presence of reducing sugar in germinating barley seeds by Benedicts reagent test
11. Study the seed germination and seedling growth under the salt stress condition.
12. Study of salt stress effect on amino acids in germinating seeds of any crop.
13. To study the chlorophyll content in leaves of growing crop plants (wheat, pea, gram and barley etc) under different salt stress condition.

Course Outcomes:

After completion of this course the students will be able to know:

- How do the plants absorb the water and minerals from the soil .
- Analyse the photosynthetic rate under various conditions, Transpiration rate and R.Q. of different respiratory substrates.
- Estimation of starch, protein and reducing sugars.
- Quantitative and qualitative test of chlorophyll.
- The effects of salt stress on germination , aseedling growth and aminoacids in germinating seeds of any crops.

Suggested Reading:

1. Practical Agronomy by R. B. Tiwari
2. A text Book of Practical Botany² by Bendre and Kumar
3. Practical Biotechnology by R.S. Gaud
4. Practical Biochemistry by Keith Wilson
5. Practical Manual of Biochemistry by S.P. Singh

Website Sources:

- <https://onlinecourses.swayam2.ac.in/>
- <http://onlinecourses.nptel.ac.in>
- <https://lab-training.com/>
- <https://www.omicsonline.org>
- <en.wikipedia.org>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-II Year (III Semester)

MBO-301: EMBRYOLOGY AND ANATOMY OF ANGIOSPERMS

Objective:

This course aims to expose the students to the following topics:

- Students should understand complete details about the structures, development of embryo at different stages including gametogenesis, fertilization, and implantation.
- Ability to correlate between the embryological structure and its significance.
- Introduce with seed and fruit development, apomixes, polyembryony and parthenocarpy.
- This course also aims to study the cellular structures and their role in plant development, tissues system, Water and food conducting elements, secondary growth in plants. The other objective of this course is to create understanding of nodal anatomy, leaf abscission and healing of wounds.

Unit – I

(08 Sessions)

Development of microsporangium, microsporogenesis, dehiscence of anther, structure of pollen grain, development of male gametophyte.

Types of ovules, structure of ovule, megasporogenesis, development of female gametophyte (embryo sac), types of embryo sac.

Unit – II

(10 Sessions)

Pollination: self-pollination and cross pollination, adaptations for pollination; special mechanism of pollination; pollen germination and pollen tube growth, syngamy and double fertilization, self incompatibility and its genetic basis.

Development of endosperm, types of endosperm, aleurone tissue, xenia and metaxenia, dicot and monocot embryos; polyembryony, apomixis, seed and fruit formation, parthenocarpy.

Unit – III

(10 Sessions)

Tissues and theories of Meristem; Meristematic and Permanent tissues; Tissue systems: epidermal, ground tissue and vascular tissue systems.

Primary structure of stem, root and leaf.

Primary anomalous structures of dicot stems: *Nyctanthes*, *Amaranthus*, *Achyranthes*, *Boerhaavia*, *Bougainvillea*, *Chenopodium*, *Capsicum* and *Calotropis*.

Unit – IV

(08 Sessions)

Normal secondary growth in dicot stem and root.

Abnormal secondary growth in selected dicot and monocot stems: *Bignonia*, *Leptadenia*, *Salvadora*, *Dracaena* and *Mirabilis*.

Unit – V

(06 Sessions)

Abscission and Healing of wounds.

Nodal Anatomy.

Anatomy of floral Parts.

Course Outcomes:

Students who successfully complete this course will be able to:

- Understand the structure of male and female reproductive bodies in flowering plants.
- Familiarize to pollination processes.
- Learn about double fertilization and their significance
- Know about the structure and development of dicot and monocot embryos.
- Understand apomixes, polyembryony and parthenocarpy.
- Understand the meristems and role in plant development.

- Draw and explain the structures of various tissues in plants and their functions.
- Know how the secondary growth takes place in some dicot stem.
- Understand the process of abscission and healing of wounds

Suggested Readings:

1. Bhojwani, S.S. and Bhatnagar, S.P. The embryology of Angiosperms.
2. Mahswari, P. An Introduction to Embryology of Angiosperms, 1950.
3. Shivanna, K.R. and Johri, B.M. The Angiosperm Pollen structure and Function, Wiley Eastern Ltd., Publications, 1989.
4. Johri, B.M., Ambegaokar, K.B. and SrivasDtava, P.S. Comparative Embryology of Angiosperms, Vol. I & II, SpringerVerlag.
5. Bhojwani, S.s. and Bhatnagar, S.P. Embryology of Angiosperms (4 th Revised and enlarged edition), 2000.
6. Carlquist S (2001). Comparative Wood Anatomy, Springer-Verlag, Germany.
7. Cutler DF (1978). Applied Plant Anatomy, Longman, United Kindom
8. Cutter EG (1978) Plant Anatomy, Part I & II, Edward Arnold, United Kingdom.
9. Dickinson WC (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA.
10. Fahn A (1974) Plant Anatomy, Pergmon Press, USA & UK
11. Leyser O and Day S (2003) Mechanism of Plant Development, Blackwell Press
12. Nair MNB (1998). Wood Anatomy and Major Uses of Wood, Faculty of Forestry, University of Putra Malaysia, Malaysia.
13. Vashistha, P. C. A text book of Plant Anatomy, S. Chand Publication, New Delhi.

Website Sources:

- www.digitalbookindex.org
- www1.biologie.uni-hamburg.de
- www.topfreebooks.org ›
- <https://sites.google.com/>
- www.pdfdrive.com/botany-books.html
- <https://gurukpo.com>
- <http://www.brainkart.com>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-II Year (III Semester)

MBO-302: PLANT PATHOLOGY

Objective: The objective of this is to develop understanding about the diseases of plant, their symptoms in plants, how the pathogens affect the physiology of plant?; effects of environment on disease development, host plant nutrition and causal organism, diseases caused by them, symptoms and disease cycle and their control methods.

Unit – I

(10 Sessions)

Introduction: Definition of disease, causes and classification of diseases, plant pathology in India, significance of plant diseases, disease cycle and symptoms of plant disease

Pathogenesis (disease development), host-parasite relationship, enzymes and microbial toxins in plant diseases.

Unit – II

(08 Sessions)

Effects of pathogens on physiology of plants, Host defense mechanism

Effect of environment on disease development, host-plant nutrition, Disease forecasting.

Unit – III

(08 Sessions)

Diseases caused by Fungi: Damping-off of seedlings, late blight of potato, downy mildew and powdery mildew of cucurbits, rusts of wheat, loose smut of wheat, covered smut of barley and wilt of pigeon pea, Non-Parasitic diseases caused by environmental factors.

Unit – IV

(10 Sessions)

Diseases caused by Bacteria and Mollicutes: General symptoms and control of bacterial diseases, bacterial leaf blight of rice, red stripe of sugarcane, bacterial rot or tundu of wheat, diseases caused by mollicutes: Witche's broom of potato

Diseases and Symptoms caused by Viruses, Classification, nomenclature and transmission of plant viruses, tobacco mosaic, yellow vein mosaic of bhindi, leaf curl of papaya, bunchy top of banana.

Unit – V

(08 Sessions)

Methods of control of plant diseases: bioinsecticides, bionematicides, bioherbicides, pest management, mechanisms of biological control; competition, antibiosis, hyperparasitism, hypovirulence, induced resistance, predation, parasitism, Biocides in crop protection.

Course Outcomes:

On completing the course, the students will be able to:

- Have the knowledge of diseases, their causal organism, symptoms of the diseases, and their control measures.
- The students will also learn how the pathogens affect the physiology of plants, host defense mechanism.
- Know the effects of environment on disease development, host plant nutrition and disease forecasting.
- The students will be taught about different methods of disease control.

Suggested Readings:

1. Agrios, G. N. 1978: Plant Pathology.
2. Aneja, K. R. 1993: Experiments in Microbiology, plant pathology and Tissue culture.
3. Cooke, A. A. 1981: Diseases of Tropical and Subtropical field, Fiber and oil plants.
4. Gangopadhyay, S. 2004: Clinical Plant Pathology.
5. Kuijit, J. 1969: The Biology of parasitic flowering plants.
6. Mahadevan, A. and R. Shridhar, 1982. Methods in physiological plant pathology.
7. Mehrotra, R. S. 1980: Plant Pathology. Tata M Hill Pub.

8. Nyvall, R. F. 1970: Field Crop Diseases Handbook.
9. Paul Khurama, S. M. 1998: Pathological Problems of Economic crop plants and their management.
10. Planke, J. E. ander, 1968: Disease Resistance in plants.
11. Planke, J. E. Vander. 1963: Plant Diseases Epidemics and control.
12. Rangaswami, G. 1979: Diseases of crop plants in India.
13. Singh, R. S. 1998: Plant Diseases.

Website Sources:

- <https://www.pdfdrive.com>
- <https://library.um.edu.mo/>
- www.digitalbookindex.org
- www1.biologie.uni-hamburg.de
- www.topfreebooks.org ›
- <https://sites.google.com/>

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-II Year (III Semester)

MBO-303: PLANT BREEDING AND BIOSTATISTICS

Objective: This course aims to understand the brief history of plant breeding and methods using plants breeding, Molecular markers and marker assisted selection, Role of Mutations and Polyploidy in crop improvement and role of statistics in plant breeding.

Unit – I **(08 Sessions)**

Plant breeding work done in India with special reference to potato, maize, rice, wheat, sugarcane and cotton. Domestication and Introduction of plants, Germplasm conservation.

Unit – II **(08 Sessions)**

Selection methods of Plant Breeding in self and cross pollinated crops- Mass selection, Pure line selection, Pedigree selection, Bulk method and Backcross method.

Unit – III **(08 Sessions)**

Inbreeding depression and Heterosis, Hybridization methods of breeding in self pollinated, cross pollinated and vegetatively propagated crops.

Unit-IV **(08 Sessions)**

Plant Breeding for disease and insect resistance, Breeding for Quality, Molecular markers and marker assisted selection, Role of Mutations and Polyploidy in crop improvement.

Unit- V **(08 Sessions)**

Biostatistics: Graphic representation of data. Measures of central tendencies (Mean, Median, Mode) and dispersion (Standard deviation). Introduction to probability and distribution.

Tests of significance: student t-test, Chi square test and F-test; Analysis of variance.

Correlation and Regression, Design of experiments-CRD, RBD, Latin square.

Course Outcomes:

On completion of the course, students will able to:

- Explain the Mendelian inheritance, post mendelian inheritance and chromosomal aberration.
- Understand the science of plant breeding.
- Study the techniques of production of new superior crop varieties.
- Get the detail knowledge about modern strategies applied in Plant Breeding for crop improvement i.e. Mass selection, Pureline Selection and Clonal selection.
- Know about exploitation of heterosis, hybrid and variety development and their release through artificial hybridization.
- Know the role of Mutations and Polyploidy in crop improvement
- Understand various statistical methods of analysis.

Suggested Readings:

1. Gupta, P.K. 1999. A text book of Cell and Molecular Biology. Rastogi Publications, Meerut, India
2. Kleinsmith, L.J. and Kish, V.M. 1995. Principles of Cell and Molecular Biology (2nd edition). Harper Collins College Publishers, New York, USA.
3. Lodish, H., Berk, A., Zipursky, S.L., Matudaria, P., Baltimoe, D. and Darnell, J. 2000.
4. Molecular, Cell Biology, W.H. Freeman and Co., New York, USA.
5. Russel, P.J. 1998. Genetics, The Benjamin/Cummings Publishing Co. Inc., USA.
6. Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetics. John Wiley and Sons, Inc. USA.
7. Satish Kumar & Parul Tyagi. Plant Breeding and Biotechnology. Pragati Prakashan . Meerut.

8. P.K. Gupta: Plant Breeding
9. B.D. Singh: Plant Breeding: Principles and Methods
10. P.K. Benargee: Biostatistics

Website Sources:

- <http://www.uky.edu/>
- <https://www.science.gov>
- <https://library.um.edu.mo/>
- www.digitalbookindex.org
- www1.biologie.uni-hamburg.de
- www.topfreebooks.org ›
- <https://sites.google.com/>
- www.pdfdrive.com/botany-books.html

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-II Year (III Semester)

MBO-304: PLANT RESOURCES AND UTILIZATION

Objective: The objective of proposed course is expose to the students of centres of origin of crop plants, concept of primary and secondary homes of domestication, green revolution in India with special reference to Norman E. Borlaug, M. S. Swaminathan, and economic importance of various plants and their products,

Unit – I **(08 Sessions)**
Origin of agriculture, world centers of domesticated plants, primary and secondary homes of domesticated plants.
Green revolution in India with special reference to contribution of Norman E. Borlaug, M. S. Swaminathan;
Second green revolution: prospects

Unit – II **(08 Sessions)**
Plants as source of food (carbohydrates, proteins and fats /oils).
Fiber and timber yielding plants.

Unit – III **(06 Sessions)**
Sugar yielding plants: sugarcane, Beet Root and Maple
Rubber yielding Plants.

Unit – IV **(08 Sessions)**
Non wood forest products (NWFPs): such as Bamboos, Rattans, raw material for paper making, gums, resins, tannins & dyes.
Non alcoholic beverages yielding plants: Tea, Coffee and Cocoa.

Unit – V **(10 Sessions)**
Medicinal Plants: Important commercially available drugs obtained from roots, stem, woods, barks, leaves, flowers and fruits.
Plants as sources of spices and condiments.

Course Outcomes:

Students who successfully complete this course will be able to:

- Know origin of Agriculture, world centers of domesticated plants.
- Understand the green revolution in India and what is the role of Norman E. Borlaug, M. S. Swaminathan?
- Have the knowledge of plants as food, sugar yielding plants, medicinal values of the plants, spices and condiments, non wood forest products and non alcoholic beverages.

Suggested Readings:

1. A manual of ethnobotany Ed., S. K. Jain, Eciatic publications Jodhpur
2. A New moral Economy to India's forests ? – Roger Feffery and Nandini Sundar (1999). Sage Pub., New Delhi.
3. Advances in Oilseeds Production and Technology, G. V. Ramanamurthy. ICAR New Delhi (1985)
4. Agricultural Botany. N. T. Gill and K. C. Vear. Garal Duekworth and Co. Ltd. London (1969)
5. Agrofrestry India Perspeetive. L.K. Jha and P. K. Sengupta. Ashish Publishing House., New Delhi
6. Allen and Unwin Ltd., London (1954) Applied Ethnobotany – E.Varghese S-VD
7. Economic Botany, B. B. Simpson and M-Conner
8. Economic Botany, Hill A. Mcgrow Hill Book Company (1962)

9. Energy Plant Species. Their use and impact on environment and development. N. El. Bassam. Publ. Jemes and Jemes (Science Publishers) U. K. (2005)
10. Field crops of India by A.K. Aiyer. Banglore Printing and Publishing Company Bangalore (1966)
11. Handbook of Agriculture, ICAR New Delhi (1969)
12. Herbal Medicines for human health. Chaudhary R.R. (1994) CBS Publishers New Delhi Contributions to Ethnobotany of India. S. K. Jain
13. Introduction to Spices, Plantation crops medicinal and arremats Plants. N. Kumar, A. Khader, P. Rangaswami, I. Iralappan

Website Sources:

- www.pdfdrive.com/botany-books.html
- onlinecourses.swayam2.ac.in
- <https://library.um.edu.mo/>
- www.digitalbookindex.org
- www.pdf.com
- en.wikipedia.org
- onlineecourses.nptel.ac.in

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-II Year (III Semester)

MBO-351: PRACTICAL (EMBRYOLOGY, ANATOMY AND PLANT PATHOLOGY)

Objective:

The course aims to share the knowledge to the students about the experiments. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations.

List of Experiments:

(08 Sessions)

Anatomy of Angiosperms

Study of anatomy of following stems: *Nyctanthes*, *Amarantus*, *Achyranthes*, *Boerhaavia*, *Bougainvillea*, *Chenopodium*, *Capsicum*, *Calotropis*, *Bignonia*, *Leptadenia*, *Salvadora*, *Dracaena* and *Mirabilis*

Embryology of Angiosperms

(08 Sessions)

1. Pollen viability test using tetrazolium chloride.
2. Study of microsporogenesis in section of anthers.
3. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (Maize, Grasses, *Cannabis sativa*, *Tradescantia*, *Brassica*, *Petunia*, *Solanum melongena* etc).
4. Study of type of ovules with the help of permanent slides.
5. To study types of placentation in section of ovary.
6. Field study of anemophily, hydrophily and zoophily in some flowers.
7. To study pollinia in *Calotropis* flower.
8. Study of monocot embryo in germinating seeds of wheat, maize and barley.
9. Study of dicot embryo in germinating seeds of Brassica, pea and gram etc.

Plant Pathology

(12 Sessions)

Study of some important bacterial, viral and fungal diseases in plants:

bacterial leaf blight of rice, red stripe of sugarcane, bacterial rot or tundu of wheat, Witche's broom of potato, tobacco mosaic, yellow vein mosaic of bhindi, leaf curl of papaya, bunchy top of banana, Damping-off of seedlings, late blight of potato, downy mildew and powdery mildew of cucurbits, rusts of wheat, loose smut of wheat, covered smut of barley and wilt of pigeon pea.

Course Outcomes:

Completing this course, students will be able to:

- Dissect out the pollinia from *Calotropis procera* flower and explain the structure.
- Explain the T.S. of anther of *Datura*.
- Understand the types of placentation in different flower bud practically and physically.
- Explain monocot embryo in germinating seeds of wheat, maize and barley.
- Describe dicot embryo in germinating seeds of Brassica, pea and gram etc
- Gain knowledge on fixation, dehydration, hand sectioning, microtome sectioning of dicot and monocot stem.

Suggested Reading:

1. O.P Sharma Practical Botany II
2. Bendre and Kumar A text Book of Practical Botany2
3. B.P. Pandey Modern Practical Botany Vol. III
4. Aneja, K. R. 1993: Experiments in Microbiology, plant pathology and Tissue culture.
5. Mehrotra, R. S. 1980: Plant Pathology. Tata M Hill Pub
6. R.S. Singh, 1998 Plant Diseases
7. P.D. Sharma Plant Pathology

Website Sources:

- <https://oer.galileo.usg.edu>
- <http://www.biologycorner.com>
- <https://www.pdfdrive.com>
- <https://library.um.edu.mo/>
- www.digitalbookindex.org

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-II Year (III Semester)

MBO-352: PRACTICAL (PLANT BREEDING, BIOSTATISTICS & ECONOMIC BOTANY)

Objectives:

The course aims to share the knowledge to the students about the experiments. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations.

List of Experiments:

(24 Sessions)

Plant Breeding & Biostatistics

1. Mendelians Inheritance ratios.
2. Statistical problems related to breeding experiments.
3. Cross pollination and emasculation.
4. Analysis of variance of data, Correlation and Regression.
5. T test, F Test, Chi square.
6. Study of food crops with special reference to carbohydrates, protein and fats on the basis of their local name, botanical name, family and their uses.
7. Study of some plant fibers:
 - a. Textile fibers: cotton, jute, sun hemp and cannabis.
 - b. Cordage fibers: coir
 - c. Fibres for stuffing: silk cotton
8. Study of medicinal plants: Poppy, Atropa, *Catharanthus roseus*, *Aloe barbedense*, *Mentha arvensis*, *Rosa sp*, Ashwagandha, Sarp Gandha etc. depending on geographical location and plant parts used.
9. Study of dyes yielding plants: Turmeric, Indigo, *Butea monosperma* etc.
10. Prepare a short list of 8 most important sources of timber in your locality. Give their local name, botanical name and families to which they belong.
11. A scientific visit of national botanical gardens/parks, a CSIR laboratory doing research on plants and their utilization and make a report of survey.

Course Outcomes:

On completion of the course, students will able to:

- Solve the genetic problems related to Mendelian inheritance, and gene interactions.
- Understand the statistical problems related to science of plant breeding.
- Perform the cross pollination and emasculation in bisexual flowers.
- Analyze the data using different method of biostatistics.
- Gain knowledge of food crops with special reference to carbohydrates, protein and fats on the basis of their local name, botanical name, family and their uses.
- Identify and explain some medicinal plants, Fibre yielding plants,.
- Identify the woods in local area with special reference to their local name, botanical name and families to which they belong.

Suggested Reading:

1. C. J. Krens, Horper and Row (1978). Ecology: The experimental analysis of distribution and abundance.
2. A text Book of Practical Botany2
3. Sharma, P.D. (2010) Ecology and Environment, (8th Ed.) Rastogi Publications, Meerut.
4. Shukla and Chandel; Ecology and Soil Science, S. Chand Publication,
5. P.K. Benargee.: Biostatistics
6. B. D. Singh. Plant Breeding, Kalyani publication.

Website Sources:

- www.pdfdrive.com/botany-books.html

- www.digitalbookindex.org
- www1.biologie.uni-hamburg.de
- www.topfreebooks.org ›
- www.pdf.com
- en.wikipedia.org
- www.yourarticlelibrary.com
- www.freebookcentre.net

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-II Year (IV Semester)

MBO-401: BIODIVERSITY CONSERVATION AND ENVIRONMENTAL MANAGEMENT

Objective: This course aims to learn the students about plant diversity, value and uses of diversity, Causes of loss of biodiversity, present scenario biodiversity loss, management system at national and international levels, conservation of biodiversity. The second objective of this course is gain the knowledge on climate change and present scenario; different kinds of pollution and their impacts on biotic and abiotic components, E-waste pollution and its management.

Unit- I **(08 Sessions)**

Biological diversity, Concept and levels, Distribution and global patterns.

The importance of biodiversity to the ecosystem, loss of biodiversity, magnitude of biodiversity in Indian geographical regions.

Unit- II **(08 Sessions)**

Terrestrial biodiversity hot spots, IUCN categories of threat, inventory and conservation, protected area network.

Biodiversity conservation strategies: *in-situ* conservation and *ex-situ* conservation, major approaches to management.

Unit- III **(08 Sessions)**

Indian case studies on conservation/management strategies (Project Tiger, Biosphere reserves), Legal protection of species and habitats, International efforts for conserving biodiversity.

Unit – IV **(08 Sessions)**

Atmospheric composition and climate: Gaseous and particulate pollutants, trend, emission scenarios,

Environmental pollution: Kinds, sources, effects on plants and ecosystems,

E-waste pollution and its management.

Unit – V **(08 Sessions)**

Climate change, drivers of climate change, greenhouse gas emission scenarios, ozone layer depletion, Consequences of climate change on plant health.

Course Outcome:

Suggested Readings:

1. Abe, T., Levin, S. A. and Higashi, M. (1997) (ed.): Biodiversity an Ecological Perspective.
2. Bradbury I.K.1990): The Biosphere.
3. Brij Gopal and Bhardwaj, N. (1979): Elements of Ecology.
4. Galston, K. J. (1996): Biodiversity: A biology of numbers and differences.
5. Greig Smith P. (1983): Quantitative Plant Ecology.
6. Hamdan, H. C. and Churchill, E. D. (1961): The Plant Community
7. Hashimoto Y et al (1990): Measurement techniques in plant sciences.
8. mKormondy E. J. (1996) (4th ed.): Concept of ecology.
9. Krattiger, A. I. et al (1994): Widening Perspectives on Biodiversity.
10. Krebs C. J. (1978): Ecology.
11. Misra K. C. (1989): Manual of plant ecology.
12. Nair, P. K. G. (1990): Principles of Environmental Biology.

Website Sources:

- www.pdfdrive.com/botany-books.html
- onlinecourses.swayam2.ac.in
- <https://library.um.edu.mo/>
- www.digitalbookindex.org
- www.pdf.com
- en.wikipedia.org
- onlinecourses.nptel.ac.in

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-II Year (IV Semester)

MBO-402: PLANT ECOLOGY

Objective: The objective this course is to familiarize the students with the environment, biotic and abiotic components, structure and function of ecosystem, energy flow, population ecology, species interaction, community ecology, successive development of plant community on different habitats, major terrestrial biome and biogeographical zone of India.

Unit – I

(10 Sessions)

The Environment, biotic and abiotic components

Ecosystem: structure and component; Ecosystem function: Energy flow & nutrient cycling, Concept of ecological niche-fundamental and realized niche, resource partitioning, character displacement.

Unit – II

(08 Sessions)

Population Ecology: Characteristics of a population, population growth curves, population regulation, life history strategies (r and K selection).

Concept of metapopulation - demes and dispersal, interdemec extinctions, age structured Populations.

Unit – III

(08 Sessions)

Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Community Ecology: community structure and attributes, species diversity: levels and its measurement; edges and ecotones.

Unit – IV

(08 Sessions)

Ecological Succession: Types; mechanisms; Concept of climax.

Structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

Unit-V

(08 Sessions)

Biogeography: Major terrestrial biomes, theory of island biogeography, biogeographical zones of India.

Course Outcomes:

On completing this course, the students will be able to:

- Understand the environment and its factors.
- Know the structure and function of ecosystem.
- Gain the knowledge of energy flow and biogeo-chemical cycle in ecosystem
- Understand the characteristics of population and concept of metapopulation.
- Explain the interactions of species and community.
- Develop the understanding of student about the successive development of plant community and structure and function of some Indian ecosystems.
- The students will also be taught about major terrestrial biomes in the world, theory of island and biogeographical zone of India.

Suggested Readings:

1. Plant Ecology – R. S. Ambsht, 1990.
2. Environmental Impact Assessment, Technology Assessment. - V. T. Covell, 1985.
3. Environmental Impact Assessment of Govardhan, 1993, Theridam.
4. Ecology workbook – R. Misra.
5. Environmental management of mining operations – B. B. Dhot 1990.
6. Progress of Plant Ecology in India – R. Misra, 1973

7. Ecology: The experimental analysis of distribution and abundance – C. J. Krens, Horper and Row (1978).
8. Ecology of halophytes – R. J. Reimold and W. H. Queens, 1974.
9. Structure and functioning – A.W.J. Freysen and T. W. Wedendrop, 1978.
10. Air pollution and forests – W. H. Smith, 1981.
11. Plant pollution ecology – A. J. Dary et. Al. 1988.
12. Plant succession and indicators – F. E. Clements.
13. Plant Ecology – Weaver and Clemests.
14. The Plant community – Hanson and Churchil, 1961.
15. Principles of environmental Biology – P.K. Nair, 1979.
16. Fundamentals of Ecology – E.P. Odum, 1996.
17. Ecology – E. P. Odum.
18. Progress of Plant Ecology Ed. I – Ed. R. Misra, dt. Al. 1973.
19. Quantitative and dynamic ecology – K. A. Kershaw.
20. Patterns of primary production in the biosphere H.F.W. Lieth. 1978.
21. Taxonomy and Ecology - V. H. Heywood.
22. Plant strategies and vegetation process 0 J. P. Grime.
23. An Introduction to Air Pollution (1995) – R. K. Trivedy.
24. Concept of Ecology (1996) – Edward J. Kormond, Prentice – Hall of India, New Delhi.
25. Practical Methods in Ecology and Environmental Science - R. K. Trivedy, P. K. Goel. Enviro Media Publ. Karad.
26. Ecology and Environment – P. D. Sharma, Rastogi publications, Meerut.
27. Concept of Ecology (Environmental Biology) - P. S. Verma, V. K. Agarwal, S. Chand and Company Ltd. New Delhi.

Website Sources:

- www.pdfdrive.com/botany-books.html
- onlinecourses.swayam2.ac.in
- <https://library.um.edu.mo/>
- www.digitalbookindex.org
- www.pdf.com
- en.wikipedia.org
- onlineecourses.nptel.ac.in

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-II Year (IV Semester)

MBO-403: PLANT BIOTECHNOLOGY

Objective: This course aims to develop the understanding of genetic engineering, recombinant DNA technology, different kinds of cloning vectors, methods of transfer of recombinant DNA into a bacterial cell, various techniques of direct gene transfer, tissue culture, culture media and its application of tissue culture in welfare of human beings, Genomic and proteomics, DNA chip technology structural and functional proteomics.

Unit – I

(08 Sessions)

Genetic Engineering: An introduction,
Recombinant DNA technology: Principles, steps in gene cloning, the tools used for cloning, restriction enzymes and their cleavage pattern; Modifications of cut ends.

Unit – II

(08 Sessions)

Cloning and expression vectors: Plasmid vectors, *Agrobacterium* based plasmid vectors (Ti and Ri plasmids), 2 μ yeast plasmid vector, Bacteriophage vectors- lambda phage, cosmids and phagemids, Bacterial artificial chromosome and yeast artificial chromosome vectors.

Unit – III

(08 Sessions)

Transfer of recombinant DNA into a bacterial host: transformation, transfection, selection and screening of recombinants

Gene transfer techniques in plants: direct methods (electroporation, microprojection bombardment, microinjection and liposome); *Agrobacterium* -mediated gene transfer in plants.

Unit – IV

(08 Sessions)

Tissue culture: Totipotency, culture media and its constituents, Explant, callus and suspension culture, culture of single cell, Protoplast fusion, direct and indirect regeneration, somatic embryogenesis, organogenesis; Acclimatization.

Practical application of plant tissue culture, Somaclonal variations, artificial seeds.

Unit – V

(10 Sessions)

Genomics and Proteomics: Rice Genome Project; Methods of gene sequencing-serial analysis of gene expression (SAGE), DNA chip (DNA microarray) technology; Proteomics-Relation between gene and proteins; structural and functional proteomics.

Course Outcomes:

After completion this course, the learners will be able to understand:

- The introduction of genetic engineering and recombinant DNA technology.
- What steps and tools would be used for cloning?
- Restriction enzyme and their cleavage pattern.
- How recombinant DNA is transferred in to bacterial host.
- Direct methods of gene transfer techniques in plants.
- Students will also be taught what is tissue culture, totipotency, different culture media, and practical applications of plant tissue culture for the welfare of human beings.
- Basic principles of DNA sequencing and evolution of DNA sequencing from classical Sanger to Next Generation Sequencing. Relevance of genomic variations and their utility.
- Utility of generating mutants with respect to forward and reverse genetics and how these mutants can be used for studying genome wide changes in gene expression.
- Comparative genomics and its utility in deciphering genome organization of a sequenced genome.
- Understand methods/procedures and different tools and techniques applied for proteome analysis. Plan and execute a proteome analysis experiment.

- Understand application of proteome analysis in plant sciences in particular and in daily life in general

Suggested Readings:

1. A Text Book of Biotech by R. C. Dubey.
2. Aneja K.P.Experiments in Microbiology, Plant pathology tissue culture and mushroom cultivation. Weshwa Prakashan, New Delhi, 1996, 2nd Ed.
3. Boyce, C.O.L. : Novo's Handbook of Practical Biotechnology. Novo Industry, A/S, 1986.
4. Dodds, J.H.and L. W. Roberts: Experiments in plant tissue culture, Cambridge Univ.Press, Cambridge, 1985.
5. Gamborg, O.L.,G.C.Phillips : Plant Cell, Tissue and organ culture, Fundamental Methods. Narosa Pub.House, New Delhi, 1995.
6. General Microbiology by S.B. Sullia and S Shantharam.Oxford & IBH, Pub.Co.2005
7. Molecular Biotechnology, Principles and Applications of Recombinant DNA- Bernard and Glick and J.J Pasternals.-Ason Press Washington 1984.
8. Razdan, M.K.: An Introduction to plant tissue culture oxford & IBH Pbl.Ltd., New Delhi, 1994.
9. Reinhert,J. and Y.P.S. Bajaj.: Applied and fundamental aspects plant cell, tissue and organ culture, Springer Verlag, Berlin, 1977.
10. Tauro, P.Kapoor, K.K.and K.S.Yadav: An Introduction to Microbiology, Wiley Estern Ltd., New Delhi 1996.

Website Sources:

- www.pdfdrive.com/botany-books.html
- onlinecourses.swayam2.ac.in
- <https://library.um.edu.mo/>
- www.digitalbookindex.org
- www.pdf.com
- en.wikipedia.org
- onlineecourses.nptel.ac.in

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-II Year (IV Semester)

MBO-451: PRACTICAL (PLANT ECOLOGY AND BIO TECHNOLOGY)

Objectives: The course aims to share the knowledge to the students about the experiments. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations.

List of Experiment: **(24 Sessions)**

1. To find out Density, Frequency, Abundance and relative density of various species in plant community through quadrat method.
2. To determine minimum size of quadrat required for reliable estimate of biomass of grass lands.
3. To study of the plant species by phenograms.
4. To study of effect of polluted water on seed germination and seedling growth of selected crop plants.
5. To study morphological and anatomical characters of some xerophytic and hydrophytic plants.
6. To determine soil moisture content and porosity of soils collected from different locations.
7. To determine the water holding capacity of soils collected from different locations.
8. To find out pH and EC of different soil samples.
9. The qualitatively estimation of CO_3^{--} , SO_4^{--} and Cl^- in the given soil samples.
10. Plasmid DNA isolation: Mineprep.
11. Agrose gel electrophoresis of isolated plasmid

Course outcomes:

After completing this course, the students will be able to:

- Find out Density, abundance, Frequency and Relative Frequency of plant species in given area by quadrat method.
- Know what effects of polluted water and saline water are on seed germination and seedling growth.
- Find out water holding capacity and qualitative presence of some mineral ions.
- Identify the hydrophytes, xerophytes and halophytes on the basis of their morphological and anatomical features.
- Measure pH and electrical conductivity of different soil samples
- Learn qualitatively estimation of CO_3^{--} , SO_4^{--} and Cl^- in the given soil samples.

Suggested Readings:

1. Practical Agronomy by R. B. Tiwari
2. A text Book of Practical Botany2 by Bendre and Kumar
3. Sharma, P.D. (2010) Ecology and Environment, (8th Ed.) Rastogi Publications, Meerut.
4. Shukla and Chandel; Ecology and Soil Science, S. Chand Publication,

Website Sources:

- <https://onlinecourses.swayam2.ac.in/>
- <http://onlinecourses.nptel.ac.in>
- <https://lab-training.com/>
- <https://www.omicsonline.org>
- www.pdfdrive.com/botany-books.html

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Master of Science in Botany Programme
M. Sc. (Botany)-II Year (IV Semester)

MBO-452: DISSERTATION

Objective:

The objective of this advanced course is to provide students with hands-on training in specialized areas of plant sciences.

Contents:

(42 Sessions)

Dissertation related to Stress Physiology, Biodiversity and Conservation, Plant Ecology, Soil Science, Natural Resources Management, Cytogenetics, Genetic Engineering and its Applications, Plant Tissue Culture, Microbiology

Course Learning Outcomes:

Students will acquire the following:

1. Training in experimental design and execution
2. Knowledge on techniques and tools of research
3. Quantitative and qualitative data analysis
4. Analysis and interpretation of data in the perspective of existing knowledge