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

MBOCC-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 for skill development.

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, Classification by Baltimore (1971), Economic importance of Viruses for skill development.

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 for skill development.
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), Webester and Weber, (2007).
General characters of fungi, cell structure and nutrition, thallus organization in fungi.Cell wall skeleton, woronin bodies.
Types of reproduction in fungi, nutrition and growth in fungi including factors affecting fungal growth.
Heterothallism, Heterokaryosis, Parasexuality and Physiological specialization in fungi for skill development.

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 toKingdomChromista.
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, RhizopusPhylum –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 for skill development

Course Outcomes:

Students completing this course will able to:

CO1 Understand the diversity of micro-organisms such as viruses, bacteria, fungi lichens, their classification, structure and growth for skill development at national level.

CO2 Increase the understanding the economic values of bacteria, fungi, mycorrhizae, lichens and develop about theoretical & technical skills about them for skill development.

CO3 Develop conceptual skill identifying microbes, pathogens, biofertilizers & lichens at national level.

CO4 Learn host –pathogen relationship and disease management for skill development.

CO5 Understand the structure and reproduction of certain selected local bacteria algae, fungi and lichens for skill development.

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	2	1	1	3
CO2	1	3	1	1	1	3	1	1	1	1	3	3
CO3	1	3	3	1	1	1	1	1	1	1	3	3
CO4	1	1	3	1	1	1	1	3	1	1	1	3
CO5	1	1	3	1	1	1	1	1	1	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

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. Mehrotra, R. S. and Aneja, R.S. 1998. An introduction to Mycology, New age, intermediate press.
6. Fungi - Kingdom Fungi Vermeulen,
7. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology (4th ed.), John Wiley & Sons.
8. Webster J, Weber R, 2007. Introduction to Fungi, Cambridge University Press
9. Michael J Carlile, Dr, Sarah C Watkinson and Graham W Gooday 2015The Fungi (Third Edition)
10. Vashishta B.R. (1990) Botany for Degree Students Part-II Fungi, S. Chand & Co. New Delhi.
11. Dubey H.C. (1990): An Introduction to Fungi Vikas Publishing House, New Delhi
12. Rajni Gupta (2020): Unitext for Fresman: Biology Artz Books

Website Sources:

- www.kopykitab.com
- www.pdfdrive.com/botany-books.html
- www.digitalbookindex.org
- cqej.altopianoblu.it › botany-notes-pdf
- www.kalyanipublication.co.in
- www1.biologie.uni-hamburg.de
- 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)

MBOCC-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 for skill development.

Unit-I (08 Session)
Algae: Classification of algae according to Fritsch, Lee and salient features of different classes of Algae. Algal pigments, food reserves, flagellation and their importance in classification for skill development.

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 for skill development.

Unit-III (10 Session)
Comparative study of classes of Chlorophyceae (*Pandorina*, *Chlorella*, *Hydrodictyon*, *Ulva*, *Fritschiella*, *Zygnema*, *Closterium*and*Caulerpa*), Xanthophyceae (*Botrydium*and*Codium)* and Bacillariophyceae *(Pinnularia*, *Navicola*), with reference torange 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 torange of structure of plant body, Range of mode of reproduction, Variation in life cycles for skill development.

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*) for skill development.

Unit-V (06 Session)
Evoltution of Sporophyte in Bryophyte, Comparative study of Bryophytes.
Economic and Ecological importance of Bryophytes for skill development
Course Outcomes:
Students completing this will be able to:

CO1 Understand the characters of algae, and their classification, algal pigmentation, type of reserved food material and flagellation for skill development.
CO2 Understand the range of thallus in algae, mode of reproduction and life cycle patterns and their economic importance at globally based for skill development.
CO3 It will help to understand the comparison between different classes of globally found algae on the basis of thallus structure, reproduction and variations life cycle for skill development.

CO4 Understand the general characters, classification and diversity of bryophytes and their structure and reproduction of various genus of bryophytes for skill development

CO5 Have the global knowledge of evolution of bryophytes, economic and ecological significance of bryophytes for skill development.

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	1	1	1	3
CO2	1	1	3	1	1	3	1	1	1	1	1	3
CO3	1	1	3	1	1	1	1	1	1	1	1	1
CO4	1	1	3	1	1	1	3	3	1	1	1	3
CO5	1	1	1	1	1	3	1	1	3	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

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 ScientificPublications. 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
- www.kalyanipublication.co.in
- www1.biologie.uni-hamburg.de
- www.topfreebooks.org ›
- www.pdf.com
- en.wikipedia.org
- onlineecourses.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)

MBOCC-103: CYTLOGY 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 for skill development.

Unit – I (06 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 for skill development.

Unit – II (14 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.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) for skill development.

Unit – III (07 Sessions)
Geneticrecombination in bacteria - transformation, conjugation and transduction, interrupted mating experiment for fine structural analysis for skill development.

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 for skill development.

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 for skill development.

Course Outcomes:
Students completing this will be able to:

- CO1 Understand the various types of microscopy like SEM, TEM, Light microscopy and their uses for skill development.
- CO2 Learn different fixation and staining techniques at local level for electron microscope for skill development.
- CO3 Describe the chromosome types, structure, chromatin material, and packaging of DNA for skill development.
- CO4 Understand the mutation, causes of mutations and their impacts on globally grown agriculture crops for skill development.
- CO5 Course will also help to enhance the knowledge of students about Mendelian inheritance, gene interaction, crossing over, linkage and extra chromosomal inheritance for skill development at local level.

PO-CO Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	2	3	1	1	1	1	1	1	3
CO2	1	3	1	2	1	1	1	1	1	1	1	3
CO3	1	3	1	1	1	1	1	1	1	1	1	3
CO4	1	3	1	1	3	1	1	1	1	1	1	3
CO5	1	3	1	1	3	1	1	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

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 Molelcular Biology. RastogiPublications,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
12. Klug, W.S., Cumming, M.R., Spencer, C.A. (2012) Concept of Genetics. 10thEdidition, San Francisco, California: Benjamin Cumming.

Website Sources:

- www.kopykitab.com
- www.pdfdrive.com/botany-books.html
- www.digitalbookindex.org
- cqej.altopianoblu.it › botany-notes-pdf
- www.kalyanipublication.co.in
- www1.biologie.uni-hamburg.de
- 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)

MBOCC-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 for skill development.

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 for skill development.

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 for skill development.

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 for skill development.

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 for skill development.

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) for skill development.

Course Outcomes:
Students who successfully complete this course will be able to:

- CO1 Understand the detailed account of the plant cell and biological membrane to enhance the global skill.
- CO2 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 for skill development.
- CO3 Explain cellular processes and mechanisms that lead to physiological functions as well as examples of pathological state for skill development on local level.
- CO4 Describe the intricate relationship between various cellular structures and their corresponding functions for skill development.

CO5 Explain the process of DNA replication prokaryotes and eukaryotes, DNA damage and its repairing, and protein synthesis for global skill development.

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	3	1	1	1	1	1	1	3
CO2	1	3	1	1	3	1	1	1	1	1	1	3
CO3	1	3	1	1	3	1	1	1	1	1	1	3
CO4	1	3	1	1	3	1	1	1	1	1	1	3
CO5	1	3	1	1	3	1	1	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

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 Molelcular Biology. RastogiPublications, Meerut, India.
9. Rastogi, S.C. Cell and Molecular Biology
10. Verma, P.S. Cell biology, Genetics, Molecular Biology
11. Russel P.J. (2010). Genetics- A Molecular Approach. Benjamin Cummings U.S.R. 3rd Edition.
12. Watson, J.D., Baker, T.A., Bell, S.P. Gann, A., Levine, M., Losick. R., (2007) Molecular Biology of the Gene, Pearson. Benjamin Cummings, CSHL Press, New York USA. 6th Edition

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)

MBOCC-151: Botany Lab-I A

Objective: The course aims to share the knowledge to enhance the skills of 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 Practical

Microbiology: (06 Sessions)

- Cultivation of bacteria from different environmental samples
- Isolationof 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 for skill development.

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)* for skill development

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) for skill development

Bryophytes: (06 Sessions)

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

Course Outcomes:

Completing this course, students will be able to:

CO1 Culture the different bacterial strains and isolate them from local environmental conditions for skill development.

CO2 Have the global knowledge of Gram staining technique for skill development.

CO3 Gain knowledge on fixation, dehydration, hand sectioning, microtome sectioning for skill development.

CO4 Observe and identify the locally found microbes, algae and fungi for skill development.

.PO-CO Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	3	3	1	1	1	1	1	1	3
CO2	1	3	2	3	3	1	1	1	1	1	1	3
CO3	1	3	1	3	3	1	1	1	1	1	1	3
CO4	1	3	3	3	3	1	1	1	1	1	3	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1

CO2	3	1	1
CO3	3	1	1
CO4	3	1	1

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 1by 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)

MBOCC-152: Botany Lab-I B

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 for skill development.

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:

CO1 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 at local level for skill development.

CO2 Isolate and separate plant DNA material of locally found plants for skill development.

CO3 Learn about karyotype analysis and solve the problems related to Mendelian experiments for skill development

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	3	3	1	1	1	1	1	1	3
CO2	1	3	1	3	3	1	1	1	1	1	1	3
CO3	1	3	1	3	3	1	3	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1

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. RastogiPublications,Meerut, India.

Website Sources:

- https://oer.galileo.usg.edu
- http://www.biologycorner.com
- 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 (II Semester)

MBOCC-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 Paleaobotany for skill development.

Unit-I (08 Sessions)
Classification of Pteridophytes with special reference to Sporne, Evolution of stele
Heterospory and origin of seed habit for skill development.

Unit – II (10 Sessions)
Structure and reproduction of *Psilopsida* (*Psilotum, Rhynia, Horneophyton, Asteroxylon), Lycopsida* (*Isoetes, Lepdodendron*), *Sphenopsida* (*Calamitis, Sphenophyllum*) *and Pteropsida* (*Ophioglosum, Osmunda, Gleichenia, Adiantum, Azolla, Salvinia*)
Economic importance of Pteridophytes for skill development.

Unit – III (08 Sessions)
Introduction of Gymnosperms, Classification with special reference to Sporne (1965).
Distribution of Gymnosperms in India, Affinities with Pteridophytes and Angiosperms for skill development.

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*) for skill development.
B. Coniferopsida: Coniferales (*Pinus, Araucaria* & *Cephalotaxus*), Taxales (*Taxus*), Ginkgoales (*Ginkgo*).
C. Gnetopsida: Gnetales (*Gnetum*) for skill development.

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 for skill development

Course Outcomes:
Completing this course, students will be able to:
CO1 Describe the morphology and anatomy of the national vascular cryptogams and gymnosperms for skill development.
CO2 Have global understanding on evolution and affinities of Pteridophytes for skill development.
CO3 Have global understanding on evolution and affinities of Gymnosperms for skill development.
CO4 Enhance their knowledge about the economic and ecological importance of these global plants for skill development.
CO5 Study about the fossils, geological time scale etc for skill development at global level.

PO-CO Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	1	1	1	1	1	3	1	1	3

CO2	1	3	3	1	1	1	3	1	3	1	1	3
CO3	1	3	3	1	1	1	3	1	3	1	1	3
CO4	1	3	3	1	1	3	1	1	1	1	1	3
CO5	1	3	3	1	1	1	3	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

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
- 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 (II Semester)

MBOCC-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 for skill development.

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 for skill development

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, APG System of Classification for skill development.

Unit- III (10 Sessions)

Description of some Dicotyledons classes.

Polypetalae with special reference to Ranunculaceae, Magnoliaceae, Papaveraceae, Nymphaeceae, Capparidaceae, Moraceae, Cactaceae, Myrtaceae, Apiaceae and Cucurbitaceae for skill development.

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 for skill development.

Unit- V (08 Sessions)

Description of some Monocotyledons for skill development

Microspermae: Orchidaceae

Epigynae: Amaryllidaceae

Coronarieae: Commelinaceae

Calycinae: Arecaceae (Palmae)

Nudiflorae: Aroideae (Araceae)

Glumaceae: Cyperaceae and Poaceae

Course Outcomes:

Students completing this course will learn:

CO1 What is the role of ICBN in plant taxonomy? What are different data sources in systematics? It will enhance global skill.

CO2 What are different methods of naming plants? What are different principles of nomenclature? Why name changes? for skill development.

CO3 What are artificial, natural and phylogenetic systems of classification for skill development at global level?

CO4 What are different methods of collecting and preserving plants? What is the importance of maintaining plants in botanic gardens for skill development at national level?

CO5 Comparison among different flowering plants groups for skill development.

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	1	1	1	1	1	1	1	1	3
CO2	1	3	3	1	1	1	1	1	1	1	1	3
CO3	1	3	3	1	1	1	1	1	1	1	1	3
CO4	1	3	1	1	1	3	1	3	3	1	1	3
CO5	1	3	3	1	1	3	1	3	3	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

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. Rajni Gupta (2012) TaxonomyPast Present and Future. Teri
3. Cracknell AP, Hayes L (2009) Introduction to Remote Sensing. CRC Press, Boca Raton, USA (Special Indian Edition)
4. Crawford DJ (2003) Plant Molecular Systematics. Cambridge University Press, Cambridge, UK.
5. Cronquist A (1981). An integrated system of classification of flowering plants. Columbia University Press, New York.
6. Hollingsworth PM, Bateman RM and Gornall RJ (1999). Molecular systematics and Plant Evolution. Taylor and Francis, London.
7. Judd WS, Campbell CS, Kellogg EA, Stevens PA and Donoghue MJ (2002) Plant Systematics: A Phylogenetic Approach. SinauerAssociaes, Inc., Massachusetts.
8. Nei M and Kumar S (2000) Molecular Evolution and Phylogenetics. Oxford University Press, New York.
9. Raven PH, Begr LR, Hassenzahl DM (2008) Environment. 6th edition. John Wiley & Sons, Inc., New York.
10. Semple C and Steel MA (2003) Phylogenetics. Oxford University Press, Oxford.
11. Simpson MG (2006) Plant Systematics. Elsevier, Amsterdam.
12. Stuessy TF (2008) Plant Taxonomy: The systematic Evaluation of Comparative Data. Columbia University Press, New York.
13. Swafford DL (2001) PAUP*. Phylogenetic analysis using parsimony (* and other methods), version 4. Sinauer Associates, Sunderland.
14. 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
- www.kalyanipublication.co.in
- www1.biologie.uni-hamburg.de
- www.topfreebooks.org ›
- www.pdf.com

- en.wikipedia.org
- onlineecourses.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)

MBOCC-203: PLANT PHYSIOLOGY

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

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) for skill development.

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, C_4 Plants, the CAM pathway for skill development.

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 for skill development.

Unit-IV (10 Sessions)

Course of growth: measurement of growth, factors affecting the growth of plants.

Growth hormones: Auxins, Gibberellins, Cytokinins, Ethylene, Abscisic Acid (ABA), Brassinosteroids,Jasmonic acid and Morphactins.

Photoperiodism and Photomorphogenesis: role of florigen and phytochrome in flowering.

Vernalization: role of vernalin and gibberellins; Seed dormancy and germination for skill development.

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 for skill development.

Course Outcomes:

CO1 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 for skill development.

CO2 This course will provide an understanding of nitrogen metabolism in plants for skill development.

CO3 This course will help to understand the Phytohormones and their role in the development of plants for skill development.

CO4 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 for skill development at global level.

CO5 The students will also learn about various types of stress and defense mechanisms in locally found plants for skill development.

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	3	1	1	1	1	1	1	3
CO2	1	3	1	1	3	1	1	1	1	1	1	3
CO3	1	3	1	1	3	1	1	1	1	1	1	3
CO4	1	3	1	1	3	1	1	1	1	1	1	3
CO5	1	3	1	1	3	1	1	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

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 (9173): PhytochemistryVol.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
- cqej.altopianoblu.it › botany-notes-pdf
- www.kalyanipublication.co.in
- www1.biologie.uni-hamburg.de
- www.topfreebooks.org ›
- www.pdf.com
- en.wikipedia.org
- onlineecourses.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)

MBOCC-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 for skill development.

Unit-I (10 Sessions)
Structure of atoms, molecules and chemical bonding, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interactions, etc) for skill development.

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 for skill development.

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) for skill development.

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 for skill development.

Unit-V (10 Sessions)
Metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins for skill development.
Secondary Metabolism: Categories of Secondary compounds Phenolics, Terpenoids and Alkaloids
Course Outcomes:
On completing this course, the students will be able to:

CO1 Understand the structure of atoms, chemical bonding of molecules for skill development at global level.
CO2 Explain the structure and functions of biomolecules for skill development.
CO3 Learn bioenergetics processes in plants for skill development.
CO4 Understand the principles of enzymes, enzyme kinetics, enzyme regulation and mechanism of enzyme action for global skill development
CO5 Students will also learn metabolism of biomolecules for skill development.

PO-CO Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	3	1	1	1	1	1	1	3
CO2	1	3	1	1	3	1	1	1	1	1	1	3
CO3	1	3	1	1	3	1	1	1	1	1	1	3
CO4	1	3	1	1	3	1	1	1	1	1	1	3
CO5	1	3	1	1	3	1	1	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

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)

MBOCC-251: Botany Lab-II A

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 for skill development.

List of Practicals: (32-Sessions)

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

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

Taxonomy of Angiosperm:

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

Dicotyledons: Ranunculaceae, Magnoliaceae, Papaveraceae, Nymphaeceae, Capparidaceae, Rutaceae, Moraceae, Myrtaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Bignoniaceae, Asteraceae, Apocynaceae and Verbenaceae. Nyctaginaceae, Polygonaceae, Lauraceae and Euphorbiaceae and Other families studied Graduation level.

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 only one plant to be submitted; Botanical trip(s).

Course Outcomes:

Completing this course, students will be able to:

CO1 Gain knowledge on fixation, dehydration, hand sectioning, microtome sectioning for skill development.

CO2 Observe and identify the local as well as globally found Pteridophytes, Gymnosperms and Flowering Plants for skill development.

CO3 Develop the skill of collection and preservation of local plant specimens for skill development.

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	3	1	1	1	1	1	1	1	3
CO2	1	3	3	1	1	3	1	1	1	1	1	3
CO3	1	3	1	3	1	1	3	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1

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. Modern Plant TaxonomybyN.S. Subrahmanyam
5. Plant TaxonomybyO.P. Sharma

6. Plant taxonomy. bySaxena 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)

MBOCC-252: Botany Lab-II B

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 for skill development.

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'srespirometer.
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.
14. Study of plant hormones on germination and seedling growth of any seasonal crop plants.

Course Outcomes:

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

CO1 How do the plants absorb the water and minerals from the soil? for skill development

CO2 Analyse the photosynthetic rate under various conditions, Transpiration rate and R.Q. of different respiratory substrates for enhancement of global knowledge.

CO3 Estimation of starch, protein and reducing sugars for enhancement of global knowledge.

CO4 Quantitative and qualitative test of chlorophyll for skill development.

CO5 The effects of salt stress on germination, a seedling growth and amino acids in germinating seeds of any locally found crops for skill development.

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1		3	1	1	1	1	1	1	3
CO2	1	3	1	3	3	1	1	1	1	1	1	3
CO3	1	3	1	3	3	1	1	1	1	1	1	3
CO4	1	3	1	3	3	1	1	1	1	1	1	3
CO5	1	3	1	3	3	1	1	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1

CO4	3	1	1
CO5	3	1	1

Suggested Readings:

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 Mannual 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)

MBOCC-301: EMBRYOLOGY AND ANATOMY OF ANGIOSPERMS

Objective:

This course aims to expose the students to the following topics for skill development:

- 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 for skill development.

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 for skill development.

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

Unit – III (10 Sessions)

Tissues and theories of Meristems; 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* for skill development.

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* for skill development.

Unit – V (06 Sessions)

Abscission and Healing of wounds.

Nodal Anatomy.

Anatomy of floral Parts for skill development.

Course Outcomes:

Students who successfully complete this course will be able to:

CO1 Understand the structure of male and female reproductive bodies in flowering plants for global skill development.

CO2 Familiarize to pollination processes, double fertilization, and development of dicot and monocot embryos and understand apomixes, polyembryony and parthenocarpy for enhancement of global knowledge.

CO3 Understand the meristems and role in plant development; primary structure of root, stem and leaf

for skill development.

CO4 Compare normal secondary growth and abnormal secondary growth for enhancement of global knowledge.

CO5 Understand the concept of abscission and healing of wound, nodal anatomy for enhancement of global knowledge.

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	1	3	1	1	1	1	1	1	3
CO2	1	3	1	1	3	1	1	1	3	1	1	3
CO3	1	3	1	1	3	1	1	1	1	1	1	3
CO4	1	3	1	1	3	1	3	1	1	1	1	3
CO5	1	3	1	1	3	1	1	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

Suggested Readings:

1. Bhojwani, S.S. and Bhatnagar, S.P. The embryology of Angiosperms.
2. Maheswari, 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 Srivastava, 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 enlargededition), 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)

MBOCC-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 for skill development.

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, Contribution of various plant pathologists.

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

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 for skill development.

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, Post harvest diseases for skill development.

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, Crown Gall disease, 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 for skill development.

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, Role of Quarantine for skill development.

Course Outcomes:

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

CO1 Have the knowledge of diseases, their causal organism, symptoms of the diseases, and their control measures for enhancement of global knowledge..

CO2 The students will also learn how the pathogens affect the physiology of plants, host defense mechanism for skill development.

CO3 Know the effects of environment on disease development, host plant nutrition and disease forecasting for skill development.

CO4 Learn host – pathogen relationship and disease management for enhancement of global knowledge.

CO5 The students will be taught about different methods of disease control enhancement of global knowledge.

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	3	1	1	1	1	3	3
CO2	1	3	1	1	1	1	2	1	1	1	1	3
CO3	1	3	1	1	2	1	1	1	3	1	3	3
CO4	1	3	1	1	1	1	3	1	1	1	3	3
CO5	1	3	1	1	3	1	1	1	1	1	3	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

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)

MBODE-303 A: 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 for skill development.

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 for skill development.

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 for skill development.

Unit – III (08 Sessions)
Inbreeding depression and Heterosis, Hybridization methods of breeding in self pollinated, cross pollinated and vegetatively propagated crops for skill development.

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 for skill development.

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 for employbilty and skill development.
Course Outcomes:
On completion of the course, students will able to:

CO1 Explain the Mendelian inheritance, post mendelian inheritance and chromosomal aberration enhancement of global knowledge.
CO2 Understand the science of plant breeding skill development
CO3 Get the detail knowledge about modern strategies applied in Plant Breeding for crop improvement i.e. Mass selection, Pureline Selection and Clonal selection skill development at national level.
CO4 Know about exploitation of heterosis, hybrid and variety development and their release through artificial hybridization for enhancement of global knowledge..
CO5 Understand various statistical methods of analysis for employbilty and skill development.

PO-CO Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	3	1	1	1	1	1	1	3
CO2	1	3	1	1	3	1	1	1	1	3	3	3
CO3	1	3	1	1	3	3	1	1	1	3	3	3
CO4	1	3	1	1	3	3	1	1	1	1	1	3
CO5	1	3	1	1	3	1	3	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	3	1

Suggested Readings:

1. Gupta, P.K. 1999. A text book of Cell and Molecular Biology. RastogiPublications,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 &ParulTyagi. Plant Breeding and Biotechnology. PragatiPrakashan. 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)

MBODE-303 B: ANALYTICAL TECHNIQUES IN PLANTSCIENCES

Objective: The objective of this course is to provide knowledge on recent technological advances like molecular biology, biotechnology, plantphysiologyand biochemistry for employbilty and skill development.

UNIT-I (08 Sessions)

Imaging and related techniques: Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching for better entrepreneurship and skill development.

UNIT-II (08 Sessions)

Cell fractionation: Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, $CSCl_2$ gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

Radioisotopes: Use in biological research, auto-radiography, pulse chase experiment for skill development.

UNIT-III (08 Sessions)

Spectrophotometry: Principle and its application in biological research.
Chromatography: Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography for better entrepreneurship and skill development.

UNIT-IV (08 Sessions)

Characterization of proteins and nucleic acids: Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE for employbilty and skill development.

UNIT-V (08 Sessions)

Biostatistics: Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit for employbilty and skill development.

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

- CO1 Learn the microscopy and its application; the different types of microscopes and what are uses of them in research for enhancement of global knowledge.?
- CO2 Understand cell fractionation by centrifugation for better entrepreneurship and skill development.
- CO3 Learn what the radioisotopes are and why they are used in research for skill development?
- CO4 Understand isolation techniques like Electrophoresis: AGE, PAGE, SDS-PAGE for analysis of DNA, RNA and proteins for employability and skill development at global level.
- CO5 Know where mean deviation, variation, standard deviation; Chi-square test are used for employability and skill development at global level.

PO-CO Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	1	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	3	3	1	1	1	1	1	1	3
CO2	1	3	1	3	3	1	1	1	1	1	1	3
CO3	1	3	1	3	3	1	1	1	1	1	1	3
CO4	1	3	1	3	3	1	1	1	1	1	1	3
CO5	1	3	1	1	3	1	1	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	2	2
CO2	3	2	2
CO3	3	2	2
CO4	3	2	2
CO5	3	2	2

Suggested Readings:

1. Plummer, D.T.(1996).AnIntroductiontoPracticalBiochemistry.TataMcGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Microtechniqueand Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel,F.,Brent,R.,Kingston,R.E.,Moore,D.D.,Seidman,J.G.,Smith,J.A.,Struhl, K. (1995). Short Protocols in Molecular Biology.JohnWiley & Sons.3rd edition.
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A.4th edition.

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)

MBODE-303 C: RECOMBINANT DNA TECHNOLOGY

Objectives: The aim of this course is to acquaint the students to versatile tools and techniques employed in recombinant DNA technology. This course conceptualize properties and applications of versatile DNA modifying enzymes, cloning strategies, vector types, host genotype specificities for selection and screening of recombinants and/or recombinant clones. Students will also be introduced to prominent nucleic acid labeling techniques. Introduction to various types of vectors viz. cloning, transformation, expression; and also vectors for genomic and cDNA library will be provided for skill development.

Unit-I (08 Sessions)

Scope of rDNA technology in various sectors, Vehicles: Plasmid and Bacteriophage; Purification of DNA: total DNA, plasmid DNA and bacteriophage DNA; enzymes used in manipulation of purified DNA. Cloning vectors based on E. coli plasmids, cloning vectors based on M13 bacteriophage and λ bacteriophage, vectors for genomic library construction, vectors for other bacteria. Vectors for yeasts and other fungi, higher plants, animal cells for skill development.

Unit-II (08 Sessions)

Rationale for the design of vectors for the over expression of recombinant proteins
Selection of suitable promoter sequences, ribosome binding sites, transcription terminator, fusion protein tags, purification tags, protease cleavage sites and enzymes, plasmid copy number, inducible expression system, promoter probe vectors for skill development.

Unit-III (08 Sessions)

Experiments using model systems: *E. coli, Yeast, Baculovirus, Agrobacterium tumifaciens*.
Basic idea of transformation, conjugation and transduction.Introduction of DNA into host cells.
Transformation and identification of recombinants, transfaction and identification of recombinants, transformation of non-bacterial cells for skill development.

Unit-IV (08 Sessions)

Obtaining clone of a specific gene: the problem of selection, direct selection, methods of identification of clone from gene library.
Locating the cloned gene in plasmid and in chromosomes using southern hybridization and chromosome walking for skill development.

Unit-V (08 Sessions)

Transcript analysis, regulation of the gene expression and identifying and studying the translation product of a cloned gene (HRT and HART techniques).
DNA sequencing methods: Sanger-Coulson method &Maxam- Gilbert method. Automated sequencing.
Whole genome analysis- preparation of ordered cosmid libraries, bacteria artificial chromosome libraries. PCR & its application.DNA finger printing (RFLP & RAPD, REP-PCR etc.); Bioinformatics for employbilty and skill development.

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

CO1 Outline the fundamental steps in a genetic engineering procedure for enhancement of global knowledge.
CO2 Describe the mechanism of action and the use of restriction enzymes in biotechnology research and recombinant protein production for enhancement of global knowledge.
CO3 Explain the usefulness of plasmid preparations, how they are performed, and how the concentration and purity of plasmid samples can be determined for skill development.
CO4 Discuss cloning strategies and techniques used to probe DNA for specific genes of interest for enhancement of global knowledge..

CO5 Conceptualize PCR technique in medical and forensic science for employability and skill development.

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	3	3	1	1	1	1	1	1	3
CO2	1	3	3	3	3	1	1	1	1	1	1	3
CO3	1	3	3	3	3	1	1	1	1	1	1	3
CO4	1	3	3	3	3	1	1	1	1	1	1	3
CO5	1	3	3	3	3	1	1	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	2	1

Suggested Readings:

1. Old & Primrose. Principals of Gene Manipulation.1994. Blackwell Scientific Publisher
2. Sambrook&Russel. Molecular Cloning.3 Volumes. 2000. CHSL Press.
3. Genome Analysis. Four volumes 2000 CHS Press.
4. T.A. Brown. Gene Cloning: An Introduction. III ed. Stanley Thrones Publ.

Website Sources:

- https://www.ncbi.nlm.nih.gov/ /
- https://www.khanacademy.org/
- https://trove.nla.gov.au/work/11788984
- https://www.ncbi.nlm.nih.gov/ /
- https://www.khanacademy.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)

MBODE-304 A: 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 for skill development.

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

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

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

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 for skill development.

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:

CO1 Know origin of Agriculture, world centers of domesticated plants for enhancement of global knowledge.
CO2 Understand the green revolution in India and what is the role of Norman E. Borlaug, M. S. Swaminathan for skill development at national level?
CO3 Have the knowledge of plants as food, sugar yielding plants for skill development
CO4 Have the knowledge of medicinal values of the plants, spices and condiments for skill development.
CO5 Have the knowledge of non-wood forest products and non-alcoholic beverages for enhancement of global knowledge.

PO-CO Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	1	1	1	3	1	1	1	3	3
CO2	1	3	1	1	1	1	1	3	3	1	3	3
CO3	1	3	3	1	1	3	1	3	3	1	3	3

CO4	1	3	3	1	1	3	1	3	3	1	3	3
CO5	1	3	3	1	1	3	1	3	3	1	3	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

Suggested Readings:

1. A manual of ethnobotany Ed., S. K. Jain, Eciatific publications Jodhpur
2. A New moral Economy to India's forests – Roger Feffery and NandiniSundar (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. GaralDuekworth 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.Varghesee 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 inpact on environment and development. N. El. Bassam. Publ. Jemes and Jemes (Science Publichers) 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 aromatic Plants. N. Kumar, A. Khader, P. Rangaswami, I. Iralappan
14. Rajni Gupta and TarunRajpal (2012) Concise Notes on Biotechnology.

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)

MBODE-304B: ETHNOBOTANY

Objective: This course aims to expose to the students of following points:

- Introduction, concept and scope of Ethnobotany.
- What methods would be used to ethno botanical Studies.
- Learn the role of Ethnobotany in modern medicine with special reference to some plants to provide employbilty skill.
- Legals aspects of protection of plant wealth, biopiracy and intellectual property rights and traditional knowledge for skill development.

UNIT-I (10 Sessions)

Ethnobotany: Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of Ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beveragesc) Resins and oils and miscellaneous uses for skill development.

UNIT-II (08 Sessions)

Methodology of Ethnobotanical studies: a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places for skill development.

UNIT-III (08 Sessions)

Role of Ethnobotany in modern Medicine: Medico-ethnobotanical sources in India; Significance of the following plants in Ethnobotanical practices (along with their habitat and morphology) a) *Azadiracthta indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria* for skill development.

UNIT-IV (08 Sessions)

Role of Ethnobotanyin modern medicine with special example *Rauvolfia sepentina, Trichopus zeylanicus, Artemisia, Withania*. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management) for skill development.

UNIT-V (08 Sessions)

Ethnobotany and legal aspects: Ethnobotany as tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge for skill development.

Course Outcomes:

On completion of this course, the students will be able to:

CO1 Conceptualize Ethnobotany as an interdisciplinary science for skill development

CO2 Restate the established methodology of Ethnobotany studies for employability and skill development

CO3 Categories various indigenous ethnic groups and their environmental practices for employability and skill development at national level.

CO4 Understand the legalities associated with Ethnobotany for enhancement of global knowledge.

CO5 Have the knowledge of Biopiracy for enhancement of global knowledge.

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	1	3	3	1	3	3	1	3	3

CO2	1	3	1	1	3	3	1	3	3	1	3	3
CO3	1	3	1	1	1	1	1	3	3	1	3	3
CO4	1	3	1	1	1	1	1	3	3	1	3	3
CO5	1	3	1	1	1	1	1	3	3	1	3	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	1
CO3	3	2	1
CO4	3	1	1
CO5	3	1	1

Suggested Readings:

1. S. K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2. S. K .Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and IBH, NewDelhi–1981
3. Lone et al,. Palaeoethnobotany
4. S. K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
5. S. K. Jain, 1990. Contributions of Indian ethnobotny. Scientificpublishers, Jodhpur.
6. ColtonC.M.1997.Ethnobotany –Principlesandapplications. JohnWileyandsons–Chichester
7. Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghatsin Andhra Pradesh, India. Botanical Survey of India. Howrah.
8. Rajiv K.Sinha–Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-1996
9. Faulks, P. J. 1958. An introduction to Ethnobotany, Moredale Pub.Ltd.

Website Sources:

- https://onlinecourses.swayam2.ac.in/
- http://onlinecourses.nptel.ac.in
- https://lab-training.com/
- https://www.omicsonline.org
- *en.wikipedia.org*
- www.pdfdrive.com/botany-books.html
- www.digitalbookindex.org
- *www1.biologie.uni-hamburg.de*
- *www.topfreebooks.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)

MBODE-304 C: DIVERSITY AND CULTIVATION OF MUSHROOMS

Objective: The objective of proposed course is to familiarize the students with diversity of mushrooms, status of mushroom research in India, various mushroom groups, and ecological role of mushrooms and how to cultivate of edible and medicinal mushrooms for entrepreneurship and skill development.

Unit-I (08 Sessions)

General characteristics and life history: Reproduction, spore print, dissemination, growth size, colour and surface textures, odour, taste, Exudation and fairy rings; Bioluminescence and economic importance.

Biodiversity of Mushrooms.

Status of Mushroom research in India.

Edible and poisonous mushrooms. Mushroom recipes, mushroom toxins, disease and pests of mushrooms for skill development.

Unit-II (08 Sessions)

Introduction to mushroom groups.

Taxonomic study of order Agaricales- Systematics of dark spored families viz., Boletaceae, Bolbiteaceae, Boudarzewiaceae, Cortivariaceae, Coprinaceae, Crepidotaceae, Entomataceae, Gomphideaceae, Paxillaceae, Russulaceae; Systematics of light spored families. Agaricaceae, Amanitaceae, Hygrophoraceae, Pluteaceae, Tricholomataceae for skill development.

Unit-III (08 Sessions)

Order Aphyllophorales: Introduction and Systematics of Cantharelloid forms, Thelephoroid forms, Cupuloid forms, Clavarioid forms, Hydnoid forms and Poroid forms.

Gasteromycetes: Introduction and Systematics of order Hymenogastrales, Lycoperdales, Nidulariales, Phallales, Podaxales and Sclerodermatales for skill development.

Unit-IV (08 Sessions)

Computer application in Mushroom Science, Formation of clade, dendrograms and sequence alignment; Knowledge to submit mushroom sequence data online, NCBI, MEGA4 and Muttalign.

Ecology of mushrooms.Role of mushrooms in forest ecosystem.

Mycorrhiza; endomycorrhiza (arbuscular mycorrhiza), Ectendomycorrhiza (arbutoidmycorrhiza), Ericoid mycorrhiza, Monotropoidmycorrhiza and orchid mycorrhiza for skill development.

Unit-IV (08 Sessions)

Tissue culture in wild mushrooms.

Preparation of compost- paddy straw, saw dust.

Cultivation of edible and medicinal mushrooms: *Agaricus, Calocybe, Flammulina, Ganoderma, Hericium, Lentinus, Pleurotu* for entrepreneurship and skill development.

Course Outcomes:

On completion of this course, the students will be able to:

CO1	Know about nutritional and medicinal value of edible mushrooms & Poisonous mushrooms for entrepreneurship and skill development at national level.
CO2	Learn about the Cultivation techniques of *Agaricus, Calocybe, Flammulina, Ganoderma, Hericium, Lentinus, Pleurotus* for skill development.
CO3	Have the knowledge of Tissue Culture for enhancement of global knowledge.
CO4	Gain knowledge on the present status of mushroom industry in India for skill development.
CO5	Know the ecological role of mushrooms for enhancement of global knowledge.

PO-CO Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	1	1	1	1	1	1	3	3	3
CO2	1	3	2	1	1	1	1	1	3	3	3	3
CO3	1	3	2	1	3	1	1	1	1	3	3	3
CO4	1	3	3	1	1	1	1	1	3	3	3	3
CO5	1	3	2	1	2	3	1	1	3	3	3	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	2	2
CO2	3	2	2
CO3	3	2	2
CO4	3	2	2
CO5	3	2	2

Suggested Readings:

1. Allen, M.F. 1991. The Ecology of Mycorrhiza. Cambridge Univ. Press, Cambridge.
2. Bakshi, B.K. 1974. Mycorrhiza and its role in forestry, FRI, Dehradun.
3. Chang, S.T. and W.A. Hayes. 1978. The Biology and Cultivation of Edible Mushrooms. Academic Press.
4. Hacskaylo, E. 1971. Mycorrhizae, USDA Forest Service Publ. No. 1189. US Govt. Printing Office, Washington, DC.
5. Hawksworth,DL; Sutton, B.C. and Ainsworth G.C. 1983. Dictionary of the Fungi. Kew, Surrey, England.
6. Krieger, LCC. 1967. The Mushroom Handbook. Dover Publications. INC New York.
7. Largent, D.L. 1977. How to identify Mushrooms to genus? I Macroscopic features. Mad River Press. Inc. Eureka.
8. Miller, O.K. Jr. 1981. Mushrooms of North America. EP Dutton, New York.
9. Singer, R. 1986. The Agaricales in Modern Taxonomy. BSMPS, Dehradun.
10. Stamets, P. and J.S. Chitton 1983. The Mushroom Cultivator, Agarikon Press, Olympia, Washington.

Website Sources:

- https://onlinecourses.swayam2.ac.in/
- http://onlinecourses.nptel.ac.in
- https://lab-training.com/
- https://www.omicsonline.org
- *en.wikipedia.org*
- www.pdfdrive.com/botany-books.html
- www.digitalbookindex.org
- *www1.biologie.uni-hamburg.de*
- *www.topfreebooks.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)

MBOCC-351: Botany Lab-III A

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 for skill development.

List of Experiments: (08 Sessions)
Anatomy of Angiosperms for skill development
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 for skill development:
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:

CO1	Dissect out the pollinia from *Calotropis procera* flower and explain the structure at local level.
CO2	Explain the T.S. of anther of Datura at local level for skill development.
CO3	Understand the types of placentation in different flower bud practically and physically for skill development.
CO4	Explain monocot embryo in germinating seeds of wheat, maize and barley for skill development.
CO5	Describe dicot embryo in germinating seeds of Brassica, pea and gram etc for skill development
CO6	Gain global knowledge on fixation, dehydration, hand sectioning, microtome sectioning of dicot and monocot stem for skill development.

PO-CO Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	1	1	1	1	1	1	1	1	3
CO2	1	3	3	2	1	1	1	1	1	2	1	3
CO3	1	3	3	1	1	2	1	1	1	1	1	3
CO4	1	3	3	1	1	1	1	1	2	1	1	3

CO5	1	3	3	2	1	1	1	1	1	1	1	3
CO6	1	3	3	1	1	1	1	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1
CO6	3	1	1

Suggested Readings:

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)
MBOCC-352: Botany Lab-III B

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 for skill development.

List of Experiments: (24 Sessions)

1. MendeliansInheritance 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, *Catharanthusroseus, Aloe barbedense, Menthaarvensis, Rosa sp*, Ashwagandha, Sarpgandha etc. depending on geographical location and plant parts used.
9. Study of dyes yielding plants: Turmeric, Indigo, *Buteamonosperma* 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.
12. DNA Isolation, amplification and ITS, RELP, RAPD analysis, DNA primers and markers. PCR and Gel electrophoresis.
13. Collection, preservation and identification of wild mushrooms
14. Cultivation of *Agaricus, Calocybe, Flammulilna, Ganoderma, Lentinus and Volvariella*

Course Outcomes:

On completion of the course, students will able to:

CO1 Solve the genetic problems related to Mendelian inheritance, and gene interactions for enhancement of global knowledge.

CO2 Understand the statistical problems related to science of plant breeding for enhancement of global knowledge.

CO3 Perform the cross pollination and emasculation in bisexual flowers for skill development.

CO4 Analyze the data using different method of biostatistics for enhancement of global knowledge.

CO5 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 for skill development at national level.

CO6 Identify and explain some medicinal plants, Fiber yielding plants for skill development.

CO7 Identify the woods in local area with special reference to their local name, botanical name and families to which they belong for skill development.

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	2	3	1	3	1	1	1	1	3
CO2	1	3	1	2	3	1	1	1	1	1	1	3

CO3	1	3	1	3	3	1	1	1	1	1	1	3
CO4	1	3	1	1	3	1	1	1	1	1	1	3
CO5	1	3	3	1	1	3	1	3	3	1	3	3
CO6	1	3	3	1	1	3	1	3	3	1	3	3
CO7	1	3	3	1	1	3	1	3	3	1	3	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1
CO6	3	1	1
CO7	3	1	1

Suggested Readings:

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 (IVSemester)

MBOCC-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 for skill development.

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 for skill development.

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 for skill development.

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 for skill development.

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 for skill development.

Unit – V (08 Sessions)
Climate change, drivers of climate change, greenhouse gas emission scenarios, ozone layer depletion, Consequences of climate change on plant health for skill development.

Course Outcome:

On completion of the course, students will able to:

CO1 Enunciate why society strives to conserve biodiversity for enhancement of global knowledge.
CO2 Identify key threats to biodiversity for enhancement of global knowledge.
CO3 Evaluate which management options are likely to be effective for conserving biodiversity in different settings for skill development.
CO4 Develop appropriate policy options for conserving biodiversity in different settings for enhancement of global knowledge.
CO5 Communicate informed critique or analysis of biodiversity conservation policy and practice across a range of mediums for enhancement of global knowledge.

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	1	1	3	3	1	3	3
CO2	1	3	1	1	1	1	1	3	3	1	3	3

CO3	1	3	1	1	1	1	1	3	3	1	3	3
CO4	1	3	1	1	1	1	1	3	3	1	3	3
CO5	1	3	1	1	1	1	1	3	3	1	3	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

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. Kormondy 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
- 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)
MBOCC-402: PLANT ECOLOGY

Objective: The objective this course is to familiarize the students with the environment, biotic and biotic 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 for skill development.

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 for skill development.

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, interdemic extinctions, age structured Populations for skill development.

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 for skill development.

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) for skill development.

Unit-V (08 Sessions)

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

Course Outcomes:

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

CO1 Understand the environment and its factors for enhancement of global knowledge.

CO2 Know the structure and function of ecosystem for enhancement of global knowledge.

CO3 Gain the knowledge of energy flow and biogeo-chemical cycle in ecosystem for skill development

CO4 Understand the characteristics of population and concept of metapopulation for enhancement of global knowledge.

CO5 Develop the understanding of student about the successive development of plant community and structure and function of some Indian ecosystems for skill development

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	1	1	3	3	1	1	3
CO2	1	3	1	1	1	1	1	3	3	1	1	3

CO3	1	3	1	1	1	1	1	3	3	1	1	3
CO4	1	3	1	1	1	1	1	3	3	1	1	3
CO5	1	3	1	1	1	1	1	3	3	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

Suggested Readings:

1. Plant Ecology – R. S. Ambsht, 1990.
2. Environmental Impact Assessment, Technology Assessment. - V. T. Covel, 1985.
3. Environmental Impact Assessment of Govordhan, 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. Daryet. 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. 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)

MBOCC-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 bacterialcell, 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 for skill development.

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 for skill development.

Unit – II (08 Sessions)

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

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 for skill development.

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 for skill development.

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:

- CO1 The introduction of genetic engineering and recombinant DNA technology for enhancement of global knowledge.
- CO2 What steps and tools would be used for cloning? for skill development
- CO3 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 for enhancement of global knowledge.
- CO4 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 for skill development.
- CO5 Understand methods/procedures and different tools and techniques applied for proteome analysis for enhancement of global knowledge.

PO-CO Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	3	1	1	1	1	1	1	3
CO2	1	3	1	1	3	1	1	1	1	1	1	3
CO3	1	3	1	1	3	3	1	1	1	1	1	3
CO4	1	3	1	1	3	1	1	1	1	1	1	3
CO5	1	3	1	1	3	1	1	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1
CO4	3	2	1
CO5	3	2	1

Suggested Readings:

1. A Text Book of Biotech by R.C.Dubey.
2. AnejaK.P.Experiments in Microbiology, Plant pathology tissue culture and mushroom cultivation.WeshwaPrakashan, 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. NarosaPub.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.andK.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)

MBOCC-451: Botany Lab-IV

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 for skill development and enterpreneurship.

.

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:

CO1 Find out Density, abundance, Frequency and Relative Frequency of plant species in given area by quadrat method for skill development at local level.

CO2 Know what effects of polluted water and saline water are on seed germination and seedling growth in locally found plants for skill development.

CO3 Find out water holding capacity and qualitative presence of some mineral ions for enhancement of global knowledge.

CO4 Identify the local hydrophytes, xerophytes and halophytes on the basis of their morphological and anatomical features for skill development.

CO5 Measure pH and electrical conductivity of different soil samples for skill development and entrepreneurship.

CO6 Learn qualitatively estimation of CO_3^{--}, SO_4^{--} and Cl^- in the given soil samples for skill development and entrepreneurship.

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	1	1	1	3	3	1	1	3
CO2	1	3	1	1	1	1	1	1	1	1	1	3
CO3	1	3	1	1	1	2	1	3	3	1	2	3
CO4	1	3	3	1	1	1	1	1	1	1	1	3
CO5	1	3	1	3	3	1	1	1	2	1	1	3
CO6	1	3	1	3	3	1	1	1	1	1	1	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	2
CO6	3	1	2

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)

MBOCC-452: DISSERTATION

Objective: The objective of this advanced course is to provide students with hands-on training in specialized areas of plant sciences for skill development and enterpreneurship.

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:

CO1 Training in experimental design and execution for enhancement of global knowledge.

CO2 Knowledge on techniques and tools of research for skill development and entrepreneurship.

CO3 Quantitative and qualitative data analysis for global skill development and entrepreneurship.

CO4 Analysis and interpretation of data in the perspective of existing knowledge for global skill development and entrepreneurship.

PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	3	1	1	1	1	1	1	3
CO2	3	3	1	2	3	1	1	1	1	1	1	3
CO3	3	3	1	1	3	1	1	1	1	1	1	3
CO4	3	3	1	1	3	1	1	1	1	1	2	3

CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	2
CO3	3	1	2
CO4	3	1	2