As per NEP 2020

M.Sc. Botany

(Effective from Academic Year 2024-2025 onwards)

Pandit Deendayal Upadhyaya Shekhawati University

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Final Credit Summary

PG in Botany

Yr	Sem	Credits							Total
		DSC	DSE/ P/D	GEC	AEC	SEC	VAC	Seminar / Internship / Dissertation	
First	Pawas	16	4	---	---	---	2	---	22
	Vasant	16	4	---	---	---	2	---	22
Second	Pawas	8	16	---	---	---	2	---	26
	Vasant	4	8	---	---	---	---	8	20
		44	32	---	---	---	6	8	90

Proposed Distribution of Credits for PG Programme

Courses	SEM I	SEM II	SEM III	SEM IV
Major DSC	DSC1(4) DSC2(4) DSC3(4) DSC4(4)	DSC5(4) DSC6(4) DSC7(4) DSC8(4)	DSC9(4) DSC10(4)	DSC11(4)
DSE	DSE1(4)	DSE2(4)	DSE3(4) DSE4(4) DSE5(4) DSE6(4)	DSE7(4) DSE8(4)
GEC	---	---	---	---
AEC	---	---	---	---
SEC	---	---	---	---
VAC	VAC1(2)	VAC2(2)	VAC3(2)	---
Seminar / Internship / Dissertation	---	---	---	Dissertation(8)
Total	22	22	26	20
	44		46	
	90			

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Curriculum Structure

Session 2024-2025 onwards

Name of the Programme: M.Sc. Botany

Year: First

Semester:I (Pawas)

	Course Code	Course Title	Contact Hrs per Week			Credits	Weightage (%)		
			L	T	P		CW$	MTE	ETE
PawasSemester I	**Discipline Specific Core (DSC):**								
	24MBO9101 T	Algae Fungi and Bryophyta	4	0	0	4	10	20	70
	24MBO9102 T	Cell and Molecular Biology	4	0	0	4	10	20	70
	24MBO9103 T	Principles of Plant Pathology & Microbiology	4	0	0	4	10	20	70
	24MBO9104 P	Botany Practical	0	0	4	4	30	-	70
	Discipline Specific Elective(DSE):								
	24MBO9105 T	Evolutionary Biology and Phytogeography	4	0	0	4	10	20	70
	OR								
	24MBO9106 T	Applied Microbiology	4	0	0	4	10	20	70
	Value Added Course (VAC):								
			2	0	0	2	10	20	70
	Seminar/Intership/Dissertation (S/I/D):								
	--	--	--	--	--	--	--	--	--
		Total				**22**			

Summary: I Semester		
S.N.	**Particulars**	**Credits**
1.	Discipline Specific Core(DSC):	**16**
2.	Discipline Specific Elective(DSE):	**04**
3.	Value Added Course(VAC):	**02**
4.	Seminar/Intership/Dissertation(S/I/D):	--
	Total	**22**
$CW (Class work): It would include attendance, assignments, class test/quiz test/assignements,ppt, play,learn by fun activities etc.		

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Curriculum Structure										
Session 2024-2025 onwards										
Name of the Programme: M.Sc. Botany										
Year: First							Semester: II (Vasant)			
VasantSemester II	Course Code	Course Title	Contact Hrs per Week			Credits	Weightage (%)			
			L	T	P		CW$	MTE	ETE	
	Discipline Specific Core(DSC):									
	24MBO9201T	Research Methdology	4	0	0	4	10	20	70	
	24MBO9202T	Pteridophytes, Gymnosperms and Paleobotany	4	0	0	4	10	20	70	
	24MBO9203T	Plant Morphology and Developmental Anatomy	4	0	0	4	10	20	70	
	24MBO9204P	BotanyLaboratory	0	0	4	2	30	-	70	
	Discipline Specific Elective(DSE):									
	24MBO9205T	Ethnobotany	4	0	0	4	10	20	70	
	OR									
	24MBO9206T	Principles of Plant Breeding	4	0	0	4	10	20	70	
	Value Added Course (VAC):									
			2	0	0	2	20	10	70	
	Seminar/Intership/Dissertation (S/I/D):									
	--	--	--	--	--	--	--	--	--	
		Total				**22**				

Summary: II Semester		
S.N.	**Particulars**	**Credits**
1.	Discipline Specific Core(DSC):	**16**
2.	Discipline Specific Elective(DSE):	**04**
3.	Value Added Course(VAC):	**02**
4.	Seminar/Intership/Dissertation(S/I/D):	--
	Total	**22**
$CW (Class work): It would include attendance, assignments, class test/quiz test/assignements,ppt, play,learn by fun activities etc.		

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Master of Botany

(CBCS) As per the NEP 2020 (Semester I to IV)
w.e.f. the Academic Session2024-25
Discipline: Botany
Faculty: Science
Paper-1

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Algae, Fungi and Bryophyta	**DSC-1 (4)**	**4**	0	**0**	10+2 from any recognized Board with Biology

Learning Objectives

To acquaint the students with the diversity, structural organization, reproduction and economic importance of Algae, Fungi and Bryophytes.

LearningOutcomes

Students will understand the morphology and organization of the thallus and their role in medicine, industry and food. Students will understand the interrelationship of algae and bryophytes.

Course Title:	**Algae, Fungi and Bryophyta**	**Course Code: 24MBO9101T**
Total Lecture hour 60		
		Hours
Unit I	**Algae:** Algae in diversified habitats (terrestrial, freshwater and marine), thallus organization, cell ultra-structure, reproduction (vegetative, asexual and sexual);Classification of algae: based on pigments, cell wall composition, reserved food material and flagellation.Salient features of cyanophyta, chlorophyta, bacillariophyta, xanthophyta, pyrrophyta, phaeophyta and rhodophyta with special reference to*Spirulina*, *Anabaena*, *Oedogonium*, *Nitella*, *Pinnularia*, *Laminaria* and *Batrachospermum*.	**15**
Unit II	**Economic importance of algae:** specially in industries, food, fodder, Biofuels, biofertilizers and algal bloom, isolation and culture of algae. **Fungi:** General characters, substrate relationship, cellstructure, thallus organization,cell wall composition, nutrition (saprobic, biotrophic and symbiotic), reproduction (asexual and sexual).Heterothallism, heterokaryosis, parasexuality, recent trends in classification of fungi.	**15**
Unit III	General account of mastigomycotina, zygomycotina, ascomycotina, basidiomycotina and deuteromycotina with special reference to *Rhizopus*, *Peronospora*,*Neurospora*, *Polyporus*, *Drechslera*and *Colletotrichum*.Economic importance of fungi in industries, medicines and as food, fungi as biocontrol agents, poisonous fungi, mycorhizae.	**15**
Unit IV	**Bryophyta**: Distribution, classification,morphology, structure, and reproduction of bryophytes.General account of marchantiales, jungermanniales,	**15**

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	anthocerotales,sphagnales, funariales and polytrichales with special referenceto *Plagiochasma*, *Notothyas*,*Sphagnum*, and *Polytrichum*.Economic importance of Bryophyta. Role of Bryophytes in plant succession. Fossil Bryophytes, evolutionary trends in Bryophytes.	

Reference Books:

1	Alexopoulus, C.J., Mims, C.W. and Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons ind.
2	Anderson, R.A. (2005) Algal Culturing Techniques. Physiological Society of America. Elsevier Academic Press, USA.
3	Fritsch, F.E. (1993, 1945). The Structure and Reproduction of Algae Vol.I, II. Cambridge University Press, Cambridge, UK.
4	Kashyap, S.R. (1932) Liverworts of Western Himalayas and Punjab Plains (VII. I & II) Research coPublications, New Delhi.
5	Richardson, D.H.S. Biology of Mosses. (1981). Blackwell Scientific Publications, Oxford.
6	Bold, H. C., Alexopoulus, C.J. and Delevoryas. T. (1980): Morphology of plant and fungi (4th Ed.) Harper & Foul Co., New Work.
7	Ghenawat, M.S., Kapoor J.N., and Narayana, H.S. (1976): A text book of Algae. Ramesh Book Depot, Jaipur.
8	Gilbert, M Smith. Cryptogamic Botany, Vol. I & II (2nd Ed.) (1985). Tata McGraw Hill. Publishing Co. Ltd., New Delhi. 11. Puri, V. Bryophytes. (1985). Atmaram& sons. Delhi, Lucknow.
9	Sharma, P.D.(1996). Introduction to Bryophytes. Ramesh Book Depot, Jaipur.

Paper-2

Cell and Molecular Biology

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Cell and Molecular Biology	DSC-2(4)	4	0	0	10+2 from any recognizedBoardwith Biology

Learning Objectives

The objective of this course is to familiarize students with the basic concepts and applications of modern techniques used in Cell and Molecular Biology.

LearningOutcomes

Upon completion of the course, students should be able to:

- Understandthefundamentalprinciplesofcellbiology.
- Explain the structure and functions of cell organelles involved in diverse cellular processes.
- Understand the basic concept of cell cycle
- Understand cell signaling and processes of cell death and cellular aging.
- Know nuclear organization, DNA structure, replication and repair, transcription, translation, gene expression and gene regulation.

Course Title:	Cell and Molecular Biology	Course Code: 24MBO9102T
Total Lecture hour 60		Hours
Unit I	**Cell structure and function:** Cell structure in eukaryotes and prokaryotes, cell organelles and their ultra-structure, functions, cytoskeleton, cytoplasmic streaming, Cell membranes: membrane dynamics and solute transport across membranes. Nucleus: Structure, nuclear pores, nucleosome organization, DNA structure, A, B & Z forms. **Structural organization of chromosomes:** Organization of chromatin – nucleosome model, euchromatin and heterochromatin, constitutive and facultative heterochromatin, special type of chromosomes, karyotype analysis,repetitive and non-repetitive DNA, C-value paradox, structure and organization of telomere, centromere and kinetochore.	15
Unit II	**Cell division and cell cycle:** Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle). **Cell signaling:** Cell signaling Hormones and their receptors, cell surface receptors, second messengers, signaling through G-protein coupled receptors, signal transduction pathways (Cyclic AMP, phospholipase C, Ca^{2+}/Calmodulin & Receptor Tyrosine Kinase pathway), regulation of signaling pathways, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing. **Cellular communication:** general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins. **Apoptosis (Programmed cell death):** Mechanism of apoptosis, Apoptosis triggered by internal & external pathways, Apoptosis-inducing factors, cancer, oncogenesis.	15

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Unit III	**Gene Structure:** - Organization and Structure of prokaryotic and eukaryotic genes; structure and role of promoters, exons, introns, terminators and enhancers. **DNA Replication:** - Mechanism of prokaryotic and eukaryotic DNA replication, replication apparatus, Origins of replication, priming and DNA polymerases. Rolling circle. **DNA damage and repair:** - Types of DNA damage, enzymes involving in repairing of DNA, excision repair, mismatch repair systems. **Transcription:** - RNA polymerases and their role, Transcription apparatus, Transcription in prokaryotes and eukaryotes, Initiation, elongation and termination, RNA processing, reverse transcription and cDNA synthesis, Ribonucleoproteins, Structure of mRNA.	**15**
Unit IV	**Regulation of gene expression in prokaryotes:** Basic models: Lac, arabinose and Tryp operons. Positive and negative controls. Regulation in viruses: Lytic and lysogenic cycle. **Regulation of gene expression in Eukaryotes**: Regulation at the chromatin level, Epigenetic changes at the chromosome level, genome imprinting, transcriptional gene regulation, epigenetic mechanisms of transcriptional gene regulation, regulation by cis-acting control elements, alternative promoters, trans-acting factors, transcriptional activator proteins, enhancers, silencers, post-transcriptional gene regulation including alternative splicing, RNA editing, RNA interference, Riboswitches, RNA stability, the role of RNA-decaying factors in gene regulation, translational regulation, posttranslational control, protein processing, proteasome complex and protein degradation.	**15**

Reference Books:

1	Krishnamurthy, K.V. (2000). Methods in Cell WallCytochemistry. CRC Press, Boca Raton, Florida.
2	Reeve, ECR. (2001).Encyclopaedia of Genetics, F. D. Publication, Chicago, USA
3	De, DN. (2000).Plant Cell. Vacuoles: An Introduction. CSIRO Publication, Collingwood, Australia.
4	De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology.(VIII Edition). Lippincott Williams and Wilkins, Philadelphia.
5	Cooper, G.M. andHausman, R.E. (2009). The Cell: A Molecular Approach. (V Edition). ASM Press& Sunderland, Washington, D.C.; Sinauer Associates, MA.
6	Becker, W.M.,Kleinsmith, LJ., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. (VIEdition). Pearson Benjamin Cummings Publishing, San Francisco.
7	Kleinsmith,L.J. and Kish, V.M. (1995). Principles of Cell and Molecular Biology (2nd Edition).Harper Collins College Publishers, New York, USA.
8	Haris, N. andOparka, K.J. (1994). Plant Cell Biology: A Practical Approach. IRL Press, atOxford University Press, Oxford, U.K.
9	Gunning, B.E.S. and Steer, M. W.(1996). Plant Cell Biology: Structure and Function. Jones and BartlettPublishers. Boston, Massachusetts.
10	Karp, G. (2010). Cell and MolecularBiology: Concepts and Experiments. VI Edition. John Wiley &Sons.Inc.
11	Griffiths, A.J.P. et. al.(2000). An introduction to genetic analysis, W.H.FreemanandCompany, New York, USA. Hall, J. L. and Moore, A.L. (1983), Isolation ofMembranes and Organelles from Plant CellsAcademic Press, London, UK.

12	Roy, S.C. and De, KK, (1999), Cell Biology, New Central Book Agency (P) Ltd.,Calcutta.
13	Hartl, D, L. (1994). Genetics, Jones and Bartlett PublishersInternational, USA.
14	Power C.8., 1984, Ce1l Biology, Himalaya Publishing Co. Mumbai.
15	Sinnott, L.C. Dunn, Dobzhansky, Principles of Genetics McGraw-Hill.
16	Gupta, P. K. Genetics, Rastogi Publication, Meerut, India
17	James D. Watson, Tania A. Baker, Stephen P. Bell & Alexander Gann 2013. Molecular Biology of the Gene. 7th Edition, Benjamin Cummings, San Francisco, California, USA.
18	Burton E. Tropp 2012. Molecular Biology: Genes to Proteins. 4th Edition, Jones & Bartlett, Burlington, USA.
19	Jocelyn E. Krebs, Elliott S. Goldstein & Stephen T. Kilpatrick 2012. Lewin's GENES XI. Jones & Bartlett, Burlington, USA.
20	Robert F. Weaver 2011. Molecular Biology 5th Edition, McGraw-Hill, NY, USA. Michael M. Cox, Jennifer Doudna & Michael O'Donnell 2011. Molecular Biology: Principles and Practice. W. H. Freeman, NY, USA.
21	Nancy Craig, Orna Cohen-Fix, Rachel Green and Carol Greider 2010. Molecular Biology: Principles of Genome Function. Oxford University Press, USA.

Paper-3
Principles of Plant Pathology & Microbiology

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Principles of Plant Pathology & Microbiology	DSC-3(4)	4	0	0	10+2 from any recognizedBoardwith Biology

Learning Objectives

The paper aims to enhance the knowledge of students on the diversity of microorganisms and plant diseases.

LearningOutcomes

The student will be able to

- Know about the diversity of microorganisms, their life forms and their economic importance.
- Develop a basic understanding of the causal factors responsible for plant diseases & methods of studying plant diseases.
- Apply the knowledge on ecological and environmental significance of microbes for the benefit of the society.
- Identify and suggest measures for the prevention and control of diseases in crop plants.

Course Title:	Principles of Plant Pathology & Microbiology	Course Code: 24MBO9103T
Total Lecture hour 60		
Unit I	**Plant diseases:**Introduction and General Account of disease development. History of plant pathology. Nature and concept of Plant Disease and Symptoms of Plant Diseases caused by plant pathogens. **Pathogenesis:**Biotic and Abiotic factors;Epidemiology: factors in disease development: Enzymes and Toxin in Plant Disease -Host specific and non-host specific toxin.	Hours 15
Unit II	**Disease Development:** Pre penetration, Penetration, post penetration and colonization. Defense mechanism in plants-Morphological and Biochemical. Plant disease management: Physical, Chemical and biological means of disease control. Biotechnological approaches to disease resistance, IPM. Microbiology:History and scope of microbiology, landmarks in microbiology, major groups of microorganisms characterization, identification and classification of microorganisms.	15
Unit III	**Morphology, ultrastructure and cultivation of bacteria:** Morphology and ultrastructure of bacteria, cytoplasmic inclusions, plasmids and endospores. **Introductory Virology:** Nomenclature and general characteristics of plant viruses, ultrastructure of TMV and Bacteriophage. Life cycle, Economic importance of viruses. Phytoplasma: General	15

	characters, morphology and Identification techniques of phytoplasma.	
Unit IV	**History, symptomology, causal organism, etiology and management of:** • Fungal diseases: Wheat Karnal bunt, Tikka disease of Groundnut • Bacterial diseases: Crown gall of stone fruits, Black rot of Crucifer • Viral diseases: Cadang-Cadang disease of Coconut, Sandal spike • Nematode disease: Ear Cockle of Wheat, Root Knot of Brinjal • Non-Parasitic Diseases: Black Heart of Potato, Mango necrosis	**15**

Reference Books:

1	Agrios, G.N. 2005. Plant Pathology, 5th edition. Academic Press, New York, USA.
2	Alexopoulos, C.J., C.W. Mims and M. Blackwell. 1996. Introductory Mycology. 4th edition, John Wiley and Sons, Inc., New York, USA
3	Mehrotra, R.S. and A. Agarwal. 2003. Plant Pathology. 2nd Edition. TATA McGrawHill. Pub. Company Ltd. New Delhi.
4	Singh, R.S. 1989. Plant Pathogens: The Prokaryotes. Oxford and IBH Publ.Company, New Delhi, India.
5	Tortora, G. j., Funke, B. R. and case, C. L.(2010) Microbiology- An Introduction.Addison Wesley Longman, Inc. California. 10th edition
6	Prescott L, Harley J, Klein D (2005) Microbiology, 6th edition, McGraw-Hill.
7	SubbaRao NS (1982) Advances in Agriculture Microbiology, Butterworth-Heinemann.

Paper-IV
Botany Laboratory

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Botany Laboratory	DSC-4(4)	4	0	0	10+2 from any recognized Board with Biology

Course Title:	Botany Laboratory	Course Code: 24MBO9104P
Total Lecture hour 60		
1	**Algae & Fungi:-** Morphological study of representative members of algae, fungi and bryophytes present in your locality in their natural habitat with special reference to: **Algae**: *Microcystis*, *Spirullina*, *Scytonema*,*Rivularia*, *Dunaliella*, *Aulosira*, *Spirogyra*, *Pediastrum*, *Hydrodictyon*, *Ulva*, *Pithophora*,*Stigeoclonium*, *Gelidium*and *Batrachospermum*: Isolation and culture of algae.	12
2	**Fungi**: *Stemonites*, *Peronospora*, *Pythium*, *Albugo*, *Rhizopus*, *Pilobolus*, *Yeast*, *Chaetomium*, *Pleospora*, *Morchella*, *Melamsora*, *Phallus*, *Polyporus*, *Drechslera*, *Curvularia*,*Phoma*, *Penicillium*.*Aspergillus*,*Colletotricum*, *Fusarium* and *Alternaria:* Isolation and culture of fungi using moistened blotters, PDA and Sabouraud's Dextrose Agar media.	12
3	1. Cytological techniques: Preparation of cytological stains, fixation of sample etc. 2. Study of size and shape of the cell 3. Study of cyclosis in Tradescantia staminal hairs. 4. Study of cell structure from onion leaf peels; demonstration of staining and mounting methods. 5. Comparative study of cell structure in onion cells, Hydrilla and spirogyra. 6. EM study of cell organelles 7. Fluorescence staining with FDA for cellviability. 8. Cell wall staining with calcofluor white 9. Study of stages in cellcycle 10. To study the mitosis by Squash technique of onion root tip 11. To study meiosis by smear technique 12. Demonstration of salivary gland chromosomes from Chironomous larva by Aceto orcein technique. 13. Isolation of chloroplast 14. Isolation of mitochondria 15. Histochemical localization of protein,carbohydrate, fats, starch, lignin 16. Demonstration of SEM and TEM. 17. Hardy-Weinberg numerical 18. Karyotype analysis: preparation of ideogram 19. Preparation of Reagents and Buffers for plant DNA isolation. 20. Gel electrophoresis to see the isolated plant DNA. 21. Plant RNA isolation	12

	22. Gel electrophoresis to see the isolated plant RNA. 23. Quantification of DNA/RNA Any other practical based on the theory syllabus.	
4	• Principles and use of different sterilization instruments like autoclave, oven, Laminar air flow system etc. • Culture media for microorganisms • Preparation of media (Potato Dextrose Agar). • Isolation of fungi from soil. • Identification of fungal isolates. • Preparation of Nutrient Agar (NA) media. • Isolation of bacteria from water. • Isolation of microbes from soil through serial dilution and streak plate method. • Characterization of bacterial isolate by Gram's staining – curd, root nodule • Counting of fungal spore by haemocytometer. • Growth curve of bacteria • Virus indexing • Submit herbarium preparations of three plant diseases occurring in your area. ❖ Any other practical based on theory.	12
5	**Study of the following diseases:** • Wheat Karnal bunt. • Tikka disease of Groundnut • Crown gall of stone fruits • Black rot of Crucifer • Cadang-Cadang disease of Coconut • Sandle spike • Root Knot of Brinjal • Ear Cockle of Wheat	12
6	Visit to local area and study of observed lower plants.	

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Practical-I (Based on 24MBO9101T, 24MBO9102T, 24MBO9103T)
Skeleton Paper

Duration: 6 Hours **Max. Marks: 100**

Q. No.	Questions	Marks Alloted
1.	(i) Identify any two algal species from the given mixture 'A'. Describe their characters with well-labelled diagrams and assign them to their taxonomic position.	8
	(ii) Make a suitable preparation of material 'B' to show the reproductive parts of the fungus. Draw well-labelled diagram. Identify the fungus giving reasons.	7
	(iii) Make a suitable preparation of vegetative/ reproductive part of the material 'C'. Draw labelled sketches. Identify the bryophyte giving reasons.	7
2.	(a) Perform the given exercise of cell biology.	10
	(b) Perform the given exercise of molecular biology.	10
3.	(i) Perform the microbiological exercise given to you. Draw suitable diagram, describe methodology and record your observations.	10
	(ii) Study the diseased plant material 'A' provided; make histopathological Investigations. Draw labelled drawing and identify the pathogen giving reasons.	10
4.	Identify and describe the given spots (1-6)	12
5.	Record	16
6.	Viva-voce	10

Theory Elective Courses: Semester I

Evolutionary Biology and Phytogeography

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Evolutionary Biology and Phytogeography	**DSE 1(4)**	**4**	0	**0**	10+2 from any recognized Board with Biology

Learning Objectives:
The course focuses on modern evolutionary theory in relation to the origins and dynamics of genetic diversity in time and space, reproductive isolation and evolutionary relationships among organismal groups. This also deals with phytogeography which includes principles of continental drift, theory of tolerance and endemism as well as local vegetations of different phytogeographical divisions of India.

Learning outcomes:
By the end of this course, students should be able to:

- Explain basic principles of Darwinian evolution.
- Understand the mechanisms of speciation and diversification.
- Understand the principles of population genetics, including selection, genetic drift, mutation, linkage, and gene flow.
- Know the processes that influence the distribution of plants across biomes, ecosystems, communities, and populations.
- Learn about phytogeographic realms, vegetation types of India and phytogeographical concepts.
- Develop an understanding of the factors that influence patterns of abundance and distribution in populations.

Course Title:	**Evolutionary Biology and Phytogeography**	**Course Code: 24MBO9105T**
Total Lecture hour 60		
		Hours
Unit I	**Evolution:**Theories of origin of Universe, origin of Earth and origin of life; Development of Evolutionary Thoughts: Lamarckism Neolamarkism, Darwin's concepts of variation, adaptation, struggle, fitness and natural selection; evolution of prokaryotes, origin and evolution of eukaryotes, origin and development of major group of organisms in geological time scale, molecular evolution. **Origin of cells and unicellular evolution:** Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and	**15**

	Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes.	
Unit II	**Paleontology and Evolutionary History:** The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi-cellular organisms; Major groups of plants and animals. **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; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.	**15**
Unit III	**Phytogeography:** Static and Dynamic, Principles of Plant Geography- Origin of Islands and Continents. Plant tectonics and Continental drifts. Plant distribution concept, Theory of tolerance, Theory of endemism; Patterns: Cosmopolitan, pantropical, continuous, discontinuous, endemic distribution; Factors affecting distribution, Age and Area hypothesis; Plant migration and barriers for plant migration. Center of origin of cultivated plants: Vavilov centers and Zhukoskycenters with plants in each region. Plant indicators. **Cladistics**: Introduction; advantages and problems. Cladistics (Phylogeny) concepts, parsimony, cladograms and trees; characters: apomorphic and plesiomorphic characters, homologous vs analogous; character states, binary and multistate characters.	**15**
Unit IV	Phytogeographical domains of World; Brief description of major terrestrial biomes. Phytogeographical division of India: Western Himalaya, Eastern Himalaya, Indus plane, Gangetic sub-mountain zone, Temperate zone, Alpine zone. Vegetation and floristics regions of India. Native taxa, naturalization of exotic taxa. Endemism; Concept of hotspots, hot spots of the world. Forest types of India. Climate, Vegetation and floristics of Rajasthan. Introduction to GPRS and Remote sensing (basics only).	**15**

Reference Books:

1	Walter's Vegetation of the Earth: Ecological Systems of the Geo-Biosphere (4th Edition) by Heinrich Walter, Siegmar-Walter Breckle. Paperback - October 2002.
2	Plant geography by George Simonds Boulger (Jan 1, 1912)
3	Edible Wild Plants of the Prairie: An Ethnobotanical Guide by Kelly Kindscher (1987)
4	Advanced Plant Geography Author: Shiv Manikant Dube. 2011 Swastik Publications.
5	Textbook of the Plant Geography of India. by F.R. Bharucha
6	Cain, S. A. (1944): Foundations of Plant Geography Harper & Brothers, N.Y.
7	Mani, M.S (1974): Ecology & Biogeography of India Dr. W. Junk Publishers, The Haque
8	Good, R. (1997): The Geography of flowering Plants (2nd Ed.) Longmans, Green & Co., Inc., London & Allied Science Publishers, New Delhi.

9	Douglas, J. Futuyma. Evolutionary Biology. Sinauer Publications.
10	Smith, J.M. Evolutionary Genetics. Oxford University Press. 1998. Print
11	Minkoff, J.C. 1983. Evolutionary Biology. Addison Wesley Publishing Company. 1983. Print.
12	Dobzhansky, T. Evolutionary Biology. Appleton – Century – Crofts, Educational Division/Meredith Corporation, New York.
13	Ayala, F.J. & Valentine, J.W. Evolving the theory of organic evolution. The Benjamin Cumming Publishing Company, Menlo Park, California. Lull. 1979. Print.
14	R.S. Organic Evolution. Light and Life Publishers, New Delhi. 1976. Print.
15	. Kathy Willis, Jennifer McElwain. The Evolution of Plants, Oxford University Press.2016. Print.
16	Kenrick, Paul, and Peter R. Crane. "The origin and early evolution of plants on land." Nature 389.6646 (1997): 33-39.

APPLIED MICROBIOLOGY

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
APPLIED MICROBIOLOGY	DSE 1(4)	4	0	0	10+2 from any recognized Board with Biology

Learning Objectives

The course aims to provide instruction in the general principles of food microbiology, understand food spoilage microorganisms, the microbiology of food preservation and fermented foods. This course will enable students to apply the learning of microbiology concepts towards the exploitation of microbial populations for industrial, environmental and sustainable agriculture.

Learning Outcomes:

After completion of the course, students will be able to understand:

- Microbial enzymes of industrial interest, microbial metabolites, wine production, food spoilage and preservation, production of dairy products (fermented milk and cheese),
- Role of microbes in agriculture (biofertilizers, biocontrol agent) and waste water treatment.
- Role of microbes in environment and archaeology
- Mycorrhizal fungi in bioremediation and sustainable agriculture.

Course Title:	Applied Microbiology	**Course Code: 24MBO9106T**
Total Lecture hour 60		**Hours**
Unit I	**Food and Dairy Microbiology:** Microbial spoilage of food products including cereals, fruits, vegetables, meat, fish, and dairy products, Factors influencing microbial growth in foods - extrinsic and intrinsic, Principles of food preservation, Food preservatives and their uses, Fermented food, wine, bakery products, cereals, and milk products, Bacteriocins and their application in food preservative (Nisin, Lactococcuslactis), food additives. Nutritional value of fermented foods. Microbiological examination of milk and milk products, source of their contamination and control.	**15**
Unit II	**Applications of Microbes in Waste Treatment:** Solid waste treatment (Landfills, incineration, composting, anaerobic digestion and pyrolysis). Waste water treatment: Pretreatment, primary, secondary (activated sludge, surface aerated basins, fluidized bed reactors, trickling filter, biotower, rotating biological contactors, membrane bioreactors and secondary sedimentation) and tertiary treatment, disinfection and odour control; Application of biofilm in waste water treatment. Microorganisms as indicators of water quality.	**15**

Unit III	**Role of Microbes in Environment:** Biodegradation of recalcitrant compounds - Pesticides, Petroleum, Polychlorinated biphenyls and other organopollutants; Lignin degradation: Lignocellulolytic microorganisms, enzymes and their applications in: Biopulping, Biobleaching, Textiles, Biofuels, Animal feed production. Bioremediation: In situ &*Ex situ* remediation, Concept of bioremediation technologies, Microbial consortium, Microbial remediation of oil spills, paper and pulp mill effluents and textile effluents; Biostimulation and Bioaugmentation. Bioaccumulation of metals and detoxification. Genetically Modified Organisms released and its environmental impact assessment.	**15**
Unit IV	**Microbes in archaeology:**Microorganisms deteriorating objects, glasses, ceramics, wood, paper, leather, textiles, metal surfaces and stone monuments. Methods of control of microbes for preservation of archaeological objects. Bioleaching of copper, gold and uranium from ore by microbes. **Biofertilizers for sustainable agriculture:** *Rhizobium*, *Azospirillum*, Azotobacter, *Azolla*, BGA -mass production methods, application methods of biofertilizers, significance of biofertilizers. **Mycorrhizal fungi:** Diversity of endo and ectomycorrhizal fungi, role in bioremediation of soil. Fungal endophytes as biocontrol agents.	**15**

Reference Books:

1	Alexander, M. Microbial ecology. John Wiley and Sons, New York.
2	Singh, B.D. Biotechnology, Kalyani Publishers, New Delhi
3	Agrios, G.N. 1999. Plant Pathology. Academic Press
4	Kale, V. and Bhusari, K. Applied Microbiology, Himalaya Publishing House.
5	Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA
6	Eldowney, S. and Waites, S. Pollution: Ecology and biotreatment. Longman, Harlow.
7	Madigan, M.T., Martinko, J.M. and Parker, J. Brock biology of microorganisms. Prentice Hall, New Jersey.
8	Mitchell, R. and Gu, J.D. Environmental microbiology. Wiley-Black well, New Jersey.
9	Evans, G.M. and John, J.C.F. Environmental biotechnology: Theory and applications. John Wiley and Sons, New York.
10	Waste Water Microbiology 2nd Edition by Bitton.
11	Satyanarayana, T., Johri, B.N. anad Prakash, A. Microorganisms in environmental management: Microbes and environment. Springer Verlag, New _York.
12	Adams M.R and Moss M.O: Food microbiology: Royal society of chemistry.

13	Dennis Allsopp and Seal, K.J. 1986. Introduction to Biodeterioration. E Edward Arnold Ltd
14	Cappucino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin Cummings Publishing Company, San Francisco.
15	Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. McGraw-Hill, New York.
16	Singer, S. Experiments in applied microbiology. Academic Press, New York.
17	Pepper, I.L, Gerba, C.P. and Brendecke, J.W. Environmental microbiology: A laboratory manual. Academic Press, San Diego

Semester - II

Research Methodology.

Paper-1

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Research Methodology	DSC-5 (4)	4	0	0	10+2 from any recognized Board with Biology

Learning Objectives

- A basic understanding of how to pursue research.
- A basic understanding of how to learn mathematics.
- A basic understanding of set theory.
- A basic understanding of the software that supports the mathematical research.

Learning Outcomes:

Aftercompletionofthiscourse,studentswill beableto

- Understand mathematics more efficiently and clearly.
- Understand how to write a basic mathematics article.
- Make students analyze a given fact or concept and how to reach a concept.
- Make students curious enough to read the most recent trends in mathematics.
- Understand the basic ideas of how to write an algorithm and related ideas.
- Understand the effective use of open-source software to write mathematical articles.

Course Title:	Research Methodology	Course Code: 24MBO9201T
Total Lecture hour 60		
Unit I	Nature of Scientific Inquiry- Scientific Methods- Induction- Deduction-Hypothesisand Theory and their Interpretation-Nature and Scope of Social Research for Multi-Disciplinary Inter-Disciplinary Approachin Commerce. Planning of Research-Selection of a Problem for Research-Sample design-Census and Sample Surveys-Sampling Techniques- Sample size.	Hours 15

Unit II	Research Design- Important Aspects of Research Design. Methods of Data Collection-Sources of data Use of secondary data- Methods of collecting primary data- Observation-Interviews- Questionnaires and Schedules.	**15**
Unit III	Processing and Analysis of Data: Processing Operations– Types of Analysis- Presentation and Interpretation of Data-Editing, Classification and Tabulation-Interpretation. Preparation of a Report- Types of Report- Research Report-Format- Principles of Writing Reports- Documentation- Footnotes and Bibliography	**15**
Unit IV	Quantitative Tools- Measures of Central Tendency- Dispersion-Measures of Correlation- Simple and Multiple Correlation-testing of Hypothesis-Tests based on t-P, Z, and Chisquare-Time Series Analysis-Trend Measurement-Moving Averages	**15**

Reference Books:

1	Srivastava, S.C.: Foundation of Social Research and Economics Techniques, Himalaya Publishing House, 1990.
2	Sharma H.D. and Mukherji S.P.: Research Methods in Economics and Business, New York: The Macmillan Company, 1992.
3	Gerber R. and Verdoom, P.J. :Research Methods in Economics and Business, NewYork, The Macmillan Company, 1992.
4	Krishna swami O.R.: Methodology of Research in Social Sciences, Himalaya Publishing House, 1993.
5	Menden HYall and Varacity: Reinmuth J.E.: Statistics for Management and Economics (2nd Edition), 1982.
6	Courtis J.K.(ed.) Research and Methodology in Accounting & Financial Management, 1980.

Paper 2

PTERIDOPHYTA, GYMNOSPERMS & PALEOBOTANY

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
PTERIDOPHYTA, GYMNOSPERMS & PALEOBOTANY	DSC-6 (4)	4	0	0	10+2 from any recognized Board with Biology

LearningObjectives:

- This course will help the student understand the diversity of early land plants and the evolutionary process in plant kingdoms.

Learningoutcomes:

Students will get in-depth knowledge of:

- The plant diversity (esp. In pteridophytes, and gymnosperms) and understanding the evolutionary trends through the study of palaeobotany.
- The evolutionary diversification of early land plants and morphological and reproductive innovations in pteridophytes and gymnosperms.

Course Title:	PTERIDOPHYTA, GYMNOSPERMS & PALEOBOTANY	Course Code: 24MBO9202T
Total Lecture hour 60		
		Hours
Unit I	**Pteridophytes:** Classification of Pteridophytes, origin and evolution of stele, telome concept, apogamy and apospory, heterospory and seed habits in Pteridophytes. Economic importance of Pteridophytes. General account of fossil Pteridophytes, Psilopsida, Lycopsida, Sphenopsida and Pteropsida classes.	**15**
Unit II	Morphology, anatomy, reproduction, classification, life history of: *Lycopodium*, *Gleichenia*, *Isoetes*, *Ophioglossum* and *Azolla*. Origin and evolution of stele, heterospory and seed habit.	**15**
Unit III	**Gymnosperms:** Distribution, morphology, anatomy, reproduction; classification, life history and evolution. Cycadales (*Zamia*), Ginkgoales (*Ginkgo*), Coniferales (*Pinus*, *Taxus*, *Araucaria*), Welwitschiales (*Welwitschia*), Gnetales (*Gnetum*).	**15**
Unit IV	**Paleobotany:** History of paleobotany, formation and types of fossils, techniques of study of fossils, Geological time scale. Brief account of Pteridospermales (*Lygenopteris*, *Caytonia* and *Glossopteris*). Brief account of Cycadeoidales (*Cycadeoidea*), Cordaitales (*Cordaites*). Palaeobotany and the evolution of vascular plants. Applied aspects of paleobotany, use in coal and petroleum exploration.	**15**
Reference Books:		
Suggested Readings:		

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1. Parihar, N.S. 1996. Biology &Morphology of Pteridophytes.Central Book Depot, Allahabad.
2. Sporne, K.K. 1991. The Morphology ofPteridophytes.B.I. Publishing Pvt. Ltd., Bombay.
3. Stewart, W.N. and Rathwell,G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press,UK.
4 Bhatnagar, S.P. and Moitra, A. 1996. Gymnosperms. New Age InternationalPyt. Ltd., New Delhi.
5. Singh, H. 1978, Embryology of Gymnosperms,Encyclopaedia of Plant Anatomy X. GebruderBortraeger, Berlin, Germany.
6. Smith,G.M. 1955. Cryptogamic Botany Vol II Tata McGraw Hill Book Co, NY.
7. Pandey,B.P.1993.College Botany. Vol. II. S. Chand and Company Ltd., New Delhi.
8. Arnold,Chester, A. 2000. An Introduction to Paleobotany. Agrobios, (India).
9. Rashid, A. 2001. An introduction to Pteridophyta (II edition). Vikas Publishing House, Pvt. Ltd., New Delhi.
10. Sunderrajan S. 2007. Introduction to Pteridophyta, New Aga International Publishers, New Delhi.

Paper- 3

PLANT MORPHOLOGY & DEVELOPMENTAL ANATOMY

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
PLANT MORPHOLOGY & DEVELOPMENTAL ANATOMY	DSC-7 (4)	4	0	0	10+2 from any recognizedBoardwith Biology

Learning Objectives:

Aim of the course is to educate students regarding differentiation of meristematic tissues, developmental biology, reproductive biology and economic botany of the flowering plants.

Learning Outcomes:

After studying of the course, students will be able to understand:

- Deals with naming and classification of plants their interrelationships and evolution.
- Highlights the strategies adopted by flowering plants for their reproduction.
- Deals with recent developments in plant systematics and phylogenetics.
- Know the techniques of herbaria preparation.

Know the methods of morphological characterization of different families and field collection and documentation

Course Title:	PLANT MORPHOLOGY & DEVELOPMENTAL ANATOMY	Course Code: 24MBO9203T
Total Lecture hour 60		
		Hours
Unit I	**Introduction:** Unique features of plant development, differences between animal and plant development. **Seed germination and seedling growth:** Metabolism of proteins and mobilization of food reserves, tropisms during seed germination and seedling growth, hormonal control of seedling growth, gene expression, use of mutants in understanding seedling development.	15
Unit II	**Shoot development:** Organization of the shoot apical meristem (SAM), cytological and molecular analysis of SAM, control of cell division and cell-to-cell communication, Stem cell in plants, Primary and Secondary tissue differentiation, control of tissue differentiation, especially xylem and phloem, secretary ducts and laticifers, wood development in relation to environmental factors.	15
Unit III	**Leaf growth and differentiation:** Inception, phyllotaxy, control of leaf form (leaf meristems and other factors), differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll, Kranz anatomy, Leaf traces and leaf gaps, transfer cells.	15
Unit IV	**Root development:** Organization of root apical meristem RAM), vascular tissue differentiation, lateral roots, root hairs, root-microbe interactions. **Seed coat development:** External and internal morphology of seed, seed appendages, ontogeny of seed coat in various families, mature structure, spermoderm patterns.	15

Reference Books:

1. Atwell, B.J.Kriedcrmann, P.E. and Jumbull, C.G.N. (eds). 1999. Plants in Action: Adaption in Nature Performance, in Cultivation, MacMillan Education. Sydney, Australia.
2. Bewley. J.D. and Black, M.1994.Seeds: Physiology of Development and Germination, Plenum Press. New York.
3. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
4. Fahn, A. 1982. Plant Anatomy. (3rd edition). Pergamon Press, Oxford. New York.
10. Raven, P.H., Evrt, R.F. and Eichhorn, S. 1992. Biology of Plants (5th edition). Worth, New York.
11. Salisbury, P.B. and Ross, C. W. 1992. Plant Physiology (4th edition).WadsworthPublishing, Belmont, California.
12. Steeves, T.A. and Sussex, I.M., 1989. Patterns in Plant Development (2nd edition) Cambridge University Press, Cambridge.
13. Waisel, Y., Eshel, A. and Kafkaki, U. (eds.). 1996. Plant Roots: The Hidden Hall (2nd edition). Marcel Dekker, New York.

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Paper-IV
Botany Laboratory

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
Botany Laboratory	DSC-4(4)	4	0	0	10+2 from any recognized Board with Biology

Course Title:	Botany Laboratory	Course Code: 24MBO9204P
Total Lecture hour 60		
1	**Suggested Laboratory Exercises:** Morphological and anatomical study of representative members of Pteridophytes in their natural habitatfound in your locality with special reference to: *Lycopodium*, *Isoetes*, *Gleichenia*,*Ophioglossum* and *Azolla* in Pteridophytes.	15
2	Morphological and anatomical study of representative members of Gymnosperms in their natural habitatfound in your locality with special reference to: *Zamia*, *Ginkgo*, *Pinus*, *Taxus*, *Araucaria* and *Gnetum* in Gymnosperms. Collection and study of fossils.	15
3	1. Study of living shoot apices by dissections using plants such as *Tabernaemontana*, *Albizia*. 2. Study of cytohistological zonation in the shoot apical meristem (SAM) in sectionedand double-stained permanent slides of a suitable plant. Examination of shoot apices in amonocotyledon in both T.S. and L.S. to show the origin and arrangement of leaf primordia. 3. Study of alternate and distichous, alternate and superposed, opposite and superposed, opposite and decussate leaf arrangement. Examination of rosette plants (*Launaea*,*Mollugo*, *Raphanus*, *Hyoscyamus* etc.) and induction of bolting under naturalconditions as well as by GA treatment. 4. Microscopic examination of vertical sections of leaves such as *Eucalyptus*, *Ficus*, *Mango*, *Nerium*, maize, grass and wheat to understand the internalstructure of leaf tissues and trichomes, glands etc. Also study the leaf anatomy C3 and C4 ofplants. 5. Study of epidermal peels of leaves such as *Coccinia*, *Tradescantia* etc. to study the development and final structure of stomata and preparethe stomatal index.	15
4	6. Study of types of stomata in plants belonging to different families. 7. Study of whole roots in monocots and dicots. 8. Examination of L.S. of root from a permanent preparation to understand the organization of root apical meristem and its derivatives. (use maize, aerial roots of banyan etc.)	15

	9. Study of lateral root development. 10. Study of leguminous roots with different types of nodules. 11.Study of primary and secondary tissue differentiation in roots and shoots. 12.Study of seed coat types- *Pisum*, *Cucurbita*, wheat. 13. Study of vascular tissues by clearing technique.	
5	Visit to local area and study of observed Higher plants.	

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Course Code: 24MBO9204P

Practical-I (Based on MBO9201T, MBO9202T, MBO9203T)

Skeleton Paper

Duration: 6 Hours **Max. Marks: 100**

Q. No.		Questions Marks Alloted
1.	(i) Problem based on research methodology.	20
2.	(i) Make a suitable preparation of vegetative/ reproductive parts of the material 'A' (Pteridophyte). Draw labelled sketches. Write features of special interest and identify giving reasons. **11** (ii) Make a suitable preparation of vegetative/ reproductive parts of the material 'B' (Gymnosperm). Draw labelled sketches. Write features of special interest and identify giving reasons. **10**	
3.	(i) Make suitable preparation of the given material. Draw labelled diagram and study the anatomical features with special reference to its vascular structure. Discuss points of special interest. **11** (iv) With the help of suitable preparation study the epidermal/ floral/ seedcoat structure of the material provided. Draw labelled diagram and comment upon its features. **10**	
4.	Identify and describe the given spots (1-6)	**12**
5.	Record **16**	
6.	Viva-voce **10**	

ETHNOBOTANY

Paper-1

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
ETHNOBOTANY	DSE-2 (4)	4	0	0	10+2 from any recognized Board with Biology

Learning Objectives:

The main objectives of this course are

- To introduce basic concept and scope of ethnobotany
- To introduce students to complementary and alternative medicine
- To explore uses of plants as medicine ranging from traditional indigenous approaches for treating ailments to modern pharmaceuticals
- To inculcate awareness about rare and threatened taxa

Learning Outcomes:

After studying this course, the students will:

1. Know concept of ethnobotany
2. Understand the lifestyle and traditional practices of plants by tribals
3. Investigate the various collection methods for ethnobotanical knowledge of tribals.
4. Understand the utility of plants as medicines
5. Build ideas to make digitization of ethnobotanical knowledge
6. Know about RET taxa

Course Title:	ETHNOBOTANY	Course Code: 24MBO9205T
Total Lecture hour 60		
Unit I	**Ethnobotany:** Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. Classification, International and National Contributions (J. W. Harshberger, R. E. Schultes, E. K. Janakiammal, S. K. Jain, K. S. Manilal, V. V. Sivarajan & P. Pushpangadan). Centres of Ethnobotanical Studies in India, AICRPE-All India Coordinated Research Project on Ethnobiology, FRLHT- Foundation for the Revitalisation of Local Health Traditions. Contributions of AICRPE and FRLHT to ethnobiology of India. Importance of ethnobotany in Indian systems of medicine (Siddha, Ayurveda and Unani), Role of AYUSH, NMPB, CIMAP.Impact of Ethnobotany in herbal-medicine industry, land-use development, agriculture, forestry, betterment of rural livelihoods and education.	Hours 15
Unit II	**Methods and techniques in ethnobotany:**Field work: Prior informed consent (PIC), PRA techniques, interviews and questionnaire methods, choice of resource persons, a few	15

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	statistical tools for data analysis; documentation of the ethnobotanical knowledge. Collection of ethnobotanical data from other sources: a) Herbarium b) Ancient Literature c) Archaeological findings d) temples and sacred places. **Ethnomedicinal plants**: Medico-ethnobotanical sources in India; Significance of the following plants in ethno botanical practices (along with their general description, habitat and morphology of the parts used):*Azadiractha indica*, *Ocimum sanctum*, *Vitex negundo*,*Gloriosa superba*, *Tribulus terrestris*,*Cassia auriculata*, *Plantago ovata*,*Aegle marmelos*and *Tinospora cordifolia*.	
Unit III	**Ethnobotany and Bioprospecting:**Role of ethnobotany in modern medicine with special examples *Rauvolfia serpentina*, *Artemisia annua*, *Withaniasomnifera*, *Commiphora wightii* and *Phyllanthus niruri*. **Traditional Knowledge:** Plants used by ethnic groups of Rajasthan as food, intoxicants, beverages, household materials, tattooing, musical instruments, magico-religious belief and for ethnoveterinary and ethnomedicinal purposes. NWFP (Non-Wood Forest Products), minerals, artefacts, and rituals, used by Tribal and Folk Communities of Rajasthan. Traditional indigenous knowledge and its importance. Ethnobotany and Ethnopharmacology as a tool to protect interests of ethnic groups and rural development.	**15**
Unit IV	**Ethnobotany and legal aspects**: Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India, Biopiracy, Intellectual Property Rights, Issues pertaining to Traditional Knowledge Patent, Indian initiatives for Traditional Knowledge protection; Challenges in the promotion of alternative and complementary medicines. **Ethno-conservation:** Role of ethnic groups in conservation of plant genetic sources; rare, endangered and threatened (RET) taxa; Tribal people and forest management in Rajasthan (*Kesar chhanta*, Orans). *In situ* conservation: Biosphere reserves,National Parks, sacred groves; *Ex situ* conservation: Botanic Gardens, Ethnomedicinal plant Gardens. Role of Ethnobotany in conservation and sustainable development.	**15**

Reference Books:

1. Jain, S. K. (1981). Glimpses of Indian Ethnobotany. Oxford & IBH publishing Co. Pvt. Ltd., New Delhi
2. S.K. Jain, 1990. Contributions of Indian Ethnobotany. Scientific publishers, Jodhpur.
3. Jain, S. K. (1989). Methods and approaches in Ethnobotany. Society of Ethnobotanists, Lucknow
4. Jain, S. K. (1995). A manual of Ethnobotany. Scientific Publishers, Jodhpur
5. Faulks, P.J. (1958). An introduction to Ethnobotany, Moredale Publ. London
6. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons –Chichester
7. Rama Rao, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in A. P., India. Bot. Survey of India. Howrah.

8. Rajiv K. Sinha – EthnobotanyThe Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-1996
9. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
10. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994. Oxford IBH pub. Co.
11. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998.Banarsidass, Delhi.
12. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.
13. Pharmacognosy, Dr. C. K. Kokate et al. 1999. Nirali Prakashan.
14. Jose Boban K. (1998). Tribal Ethnomedicine: Continuity and change. APH publishing corporation 5, Ansari Road, Darya Ganj, New Delhi
15. Phytochemical Methods. Harborne JB. 1984. Chapman and Hall, London
16. P. C. Trivedi 7 N.K. Sharma, 2004. Ethnomedicinal Plants. Pointer Publishers

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PRINCIPLES OF PLANT BREEDING

Paper-1

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria
		Lecture	Tutorial	Practical/ Practice	
PRINCIPLES OF PLANT BREEDING	DSE-2 (4)	4	0	0	10+2 from any recognized Board with Biology

Learning Objective:

This course is aimed to impart theoretical knowledge and practical skills about plant breeding objectives, modes of reproduction and genetic consequences, breeding methods for crop improvement.

Learning Outcomes:

After completion of the course students will be able to understand:

- Objectives and scope of plant breeding.
- They will acquire knowledge of selection methods and other breeding practices.
- This course will help the students to understand a wholesome review on the fundamentals of plant breeding.

Course Title:	ETHNOBOTANY	Course Code: 24MBO9206T
Total Lecture hour 60		Hours
Unit I	**Overview & Historical perspectives:** History of Plant Breeding-the pioneers, their theories and plant breeding techniques. **Reproductive systems:** Importance of Mode of Reproduction, Types of Reproduction, Autogamy, Haploids and double haploids: their application in plant breeding, Allogamy, Inbreeding depression, hybrid vigour, Hybridization, wide crosses, clonal propagation and In vitro culture.	15
Unit II	**Germplasm for Breeding:** Variation-Types, origin and scale, Plant Domestication- Centres & Models, Plant Genetic resources -Importance & Sources of Germplasm, Concept of Gene pools, Crop vulnerability, Germplasm conservation: *In situ&Ex situ*, Types of Germplasm collection, Germplasm storage technologies, Plant explorations & Introductions & their impact on agriculture. **Selection Methods:** Breeding -self-pollinated species- Mass selection, pure line selection, Pedigree selection & Bulk population; cross-pollinated species -hybrid cultivars and clonally propagated species.	15
Unit III	**Breeding Objectives:** Yield and morphological trait- Yield potential, Harvest Index, breeding for lodging resistance, shattering resistance, plant stature & early maturity; Quality traits- breeding for improved protein content, improved fatty acid content, seedlessness in fruits, delayed ripening & novel traits, Breeding for resistance to disease & insect pests - Resistance	15

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	Breeding strategies; Abiotic Stresses -Breeding for drought resistance, cold tolerance, salt tolerance, heat stress, aluminium toxicity, Oxidative stress, resistance to water logging.	
Unit IV	**Molecular Breeding:** Molecular markers- classification, Mapping of Genes- gene maps & QTL mapping, Marker assisted selection, Mutagenesis and Polyploidy in Plant Breeding. **Marketing and Societal issues in Breeding:** Performance and Evaluation for crop cultivar release, Seed certification and commercial seed release, Regulatory and Legal issues, Value driven concepts and social concerns, International Plant breeding Efforts. Plant cultivar protection, legislation, patenting and transgenics.	**15**
Reference Books:		

Suggested Readings:

1. George Acquaah.2012 Principles of Plant Genetics and Breeding. Wiley-Blackwell.
2. B.D.singh and A.K.Singh.2015.Marker Assisted Plant Breeding Springer.
3. B.D.singh .2015.Plant Breeding principles & Methods .Kalyani Publishers.
4. Jack Brown, Peter Caligari and Hugo campos. 2014. An Introduction to Plant Breeding.Wiley.
5. B rown and Caligari, 2008.An Introduction to Plant Breeding.Blackwell Publishing.
6. Chopra VL. 2001. Breeding Field Crops. Oxford & IBH.
7. Chopra VL. 2004. Plant Breeding. Oxford & IBH.
8. Gupta SK. 2005. Practical Plant Breeding. Agribios. Jodhpur
9. Roy D. 2003. Plant Breeding, Analysis and Exploitation of \ariation. Narosa Publ. House.
10. Sharma JR. 2001. Principles and Practice of Plant Breeding. Tata McGraw-Hill.
11. Simmonds NW. 1990. Principles of Crop Improvement. English Language Book Society.
12. Dana, Sukumar. 2001. Plant Breeding. Naya Udyog, Calcutta. 700 006
13. Kucku, Kobabe and Wenzel (1995). Fundamentals of Plant Breeding. Narosa Publishing House.
14. Singh BD. 2006. Plant Breeding. Kalyani.
15. Singh P. 2002. Objective Genetics and Plant Breeding. Kalyani.
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