MAA Pateshwari University, Balarampur, U.P

To,
The Registrar,
MAA Pateshwari University,
Balarampur, U.P

Date: 18/08/2025

Subject: Discussion on approval of unified syllabus of Botany regarding to New Education Policy (NEP)

Respected Sir,

The virtual meeting of Board of Studies (BOS) was organized on **09/04/2025, 20/06/2025 31/07/2025, 01/08/2025 and 17/08/2025** for preparing the unified syllabus of PG (Two Year) with respect to NEP.

Following members participated in the discussion.

S.No.	Name of Expert/BOS Member	Designation	Department	College/ University
1.	Dr. Rekha Sharma	Convener	Department of Botany	S.L.B.S. Degree College, Gonda
2.	Dr. Shiv Mahendra Singh	Member	Department of Botany	M.L.K. P.G. College, Balrampur
3.	Dr. Deepak Kumar Singh	Member	Department of Botany	A.N.D. Kisan P.G. College, Babhnan, Gonda
4.	Prof. Anil Kumar Dwivedi	Member	Department of Botany	D. D. U. University, Gorakhpur
5.	Prof. N.K Singh *(Ret. Principal)*	Member	Department of Botany	M.L.K. P. G. College, Balrampur
6.	Dr. Ashutosh Kumar Verma	Member	Department of Botany	Siddharth University, Kapilvastu, Siddharth Nagar

After discussion and amendment, the committee reached on a common platform. The unanimously accepted unified syllabus is enclosed as pdf for your kind approval.

With Regards

Rekha

Dr. Rekha Sharma (Convener)
Department of Botany
S.L.B.S. Degree College, Gonda

PROPOSED STRUCTURE OF P.G. (BOTANY)
SYLLABUS CBCS (NEP)
DEPARTMENT OF BOTANY
(FACULTY OF SCIENCE)
MAA Pateshwari University, Balarampur, U.P.

Syllabus Developed/Proposed by				
S.No.	**Name of Expert/BOS Member**	**Designation**	**Department**	**College/ University**
1.	Dr. Rekha Sharma	Convener	Department of Botany	S.L.B.S. Degree College, Gonda
2.	Dr. Shiv Mahendra Singh	Member	Department of Botany	M.L.K. P. G. College, Balrampur
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6	Dr. Ashutosh Kumar Verma	Member	Department of Botany	Siddharth University, Kapilvastu, Siddharth Nagar

Dr. Rekha Sharma (Convener)

Dr. Shiv Mahendra Singh

Dr. Deepak Kumar Singh

Prof. Anil Kumar Dwivedi

Prof. N.K Singh

Dr. Ashutosh Kumar Verma

Outline of semester-wise papers with titles and credits in M.Sc. (Botany)

Sem.	Course Code	Paper title	Type	Credit	Semester Credits
First Year					
I	**MBOT-101C**	Microbiology	Core theory	**4+0**	**20**
	MBOT-102C	Fungi, Plant Pathology and Lichen	Core theory	**4+0**	
	MBOT-103C	Algae and Bryophytes	Core theory	**4+0**	
	MBOT-104C	Pteridophyta, Gymnosperms and Palaeobotany	Core theory	**4+0**	
	MBOT-105P	Practical based on core **(MBOT-101C to MBOT-104C)**	Practical	**0+4**	
II	**MBOT-201C**	Angiosperms I: Taxonomy and Biosystematics	Core theory	**4+0**	**20**
	MBOT-202C	Angiosperms II: Morphology, Embryology and Anatomy	Core theory	**4+0**	
	MBOT-203C	Cytology and Genetics	Core theory	**4+0**	
	MBOT-204C	Soil Science and Phytogeography	Core theory	**4+0**	
	MBOT-205P	Practical based on core **(MBOT-201C to MBOT-204C)**	Practical	**0+4**	
Second Year					
III	**MBOT-301C**	Plant Biochemistry	Core theory	**4+0**	**24**
	MBOT-302C	Plant Physiology	Core theory	**4+0**	
	MBOT-303C	Plant Ecology	Core theory	**4+0**	
	MBOT-304C	Cytogenetics, Plant Breeding and Biostatistics	Core theory	**4+0**	
	MBOT-305P	General Practical **(MBOT-301C-MBOT-304C)**	Practical	**0+4**	
	MBOT-306R	Industrial training/Survey/Research Project/Botanical Excursion	Project	**0+4**	
IV	**MBOT-401C**	Molecular Biology and Biotechnology	Core theory	**4+0**	**24**
	MBOT-402C	Plant Resource Utilization and Conservation	Core theory	**4+0**	
	MBOT-403P	General Practical **(MBOT-401C- MBOT-402C)**	Practical	**0+4**	
	MBOT-404E (A, B, C & D)	Special Elective Paper	Elective theory	**4+0**	
	MBOT-405D	Dissertation and Viva-voce	Dissertation	**0+8**	

Special Elective Paper (Choose any one)
(4+0 Credits Each)

S.No.	Code: MBOT-404E (A, B, C & D)	Special Elective Paper
1.	MBOT-404E / (A)	Advance Plant Pathology
2.	MBOT-404E / (B)	Advance Plant Taxonomy
3.	MBOT-404E / (C)	Advance Plant Physiology
4.	MBOT-404E / (D)	Forest Ecology

Every course is of 100 marks, distributed into 75 external and 25 internal assessment marks.

M.Sc. BOTANY (SEMESTER-I)

Paper-I

MICROBIOLOGY

(Course Code: MBOT-101C)

4 Credits/60 Lectures

Marks: 25+75

Student Learning Outcomes:

- Learn about the major phyla and prokaryotic domains; the structure and function of prokaryotic cells; the bacterial genome and plasmids; DNA replication; the mechanisms of genetic recombination in bacteria; gene expression; and the Operon concept.
- Understand metabolic diversity in bacteria; biotechnological applications of microbes in various spheres; mode of action of antibiotics and the development of antibiotic resistance in microbes.
- Develop knowledge of viruses and their features, including their categorization according to morphological and genomic attributes, the biochemistry of host-virus interactions, transmission characteristics, and the molecular basis of their interactions with vectors.
- Learn about the biology of the virus, its replication, genome expression techniques, bacteriophage structural diversity, and how the genetic switch works.
- Learn about the techniques involved in the purification of viruses; use of serological and nucleic acid hybridization techniques in viral diagnosis; modern approaches in the control of plant viruses; role of microbes in recombinant DNA technology.

Unit–I

Introduction to microbiology: Systematics and taxonomy of microorganisms, new approaches to microbial taxonomy/classification (ribotyping and ribosomal RNA sequencing), Endosymbiotic hypothesis, The microbial cell: general organization of cell and cell wall of prokaryotes, eukaryotes and Archaea, Sterilization techniques, Inoculation methods, Culture media, Isolation of pure cultures, Maintenance and preservation of cultures. Bacterial growth, growth curve and measurement of growth.

Unit–II

Genetic analysis of bacteria: Types of bacterial transposons. Plasmids: types, function and application. Conjugation: molecular mechanism of gene transfer and regulation. Conjugation mapping, Transformation: molecular mechanism of transformation. *Transduction:* Generalized and specialized transduction-T4, T7 and lambda phages. Lysogenic phages: genome organization and its regulation.

Unit–III

Nomenclature and classification of plant viruses, Gene expression strategies in plant viruses; Hypersensitivity in host-virus interaction, Molecular aspects of virus-vector relationship in transmission, Virus detection by serological and nucleic acid hybridization methods, Structure, replication and pathogenicity of viroids, virusoids, satellite viruses and Prions. Purification of plant viruses, Bioassay test for viral purity, Quantification, Ultracentrifugation, Density gradient centrifugation.

Unit–IV

Bacterial photosynthesis (anoxygenic and oxygenic), Bacterial fermentative pathways: lactic acid, propionic acid, mixed and butanol fermentation, Nitrogen metabolism, Antibiotics and their mode of action. Basic principles of immunology, vaccines and antibodies. Application of microbiology in human welfare.

Suggested Readings:

- Matthew's Plant Virology, R. Hull, 4th edition, 2003, Elsevier.
- Prescott's Microbiology, J. Willey, L. Sherwood, 10th edition, 2017, McGraw-Hill Education.
- Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Edited by A. Hofmann, S. Clokie, 8th edition, 2018, Cambridge University Press.
- Plant Pathology, G.N. Agrios, 5th edition, 2005, Elsevier.
- Alcamo's Fundamentals of Microbiology, J.C. Pommerville, 2nd edition, 2013, Jones and Bartlett Learning.
- Microbiology: An Introduction, G.J. Tortora, B.R. Funke, C.L. Case, 11th edition, 2016, Pearson India Education.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

M.Sc. BOTANY (SEMESTER-I)

Paper-II

(Course Code: MBOT-102C)

FUNGI, PLANT PATHOLOGY AND LICHENS

4 Credits/60 Lectures

Marks: 25+75

Student Learning Outcomes:

- Students will be able to develop mycological knowledge and skill to conduct independent research.
- Know the fungal disease symptoms and their management.
- Understand the host pathogen interactions and also host defence mechanisms.
- Have an understanding of the epidemiology, symptoms, etiology, prevention and control of fungal diseases.
- Learn about plant diseases caused by fungal-like organisms, nematodes and abiotic factors
- Have an idea of the classification, structure, distribution, reproduction and importance of lichens.

Unit – I

Principles of important systems of classification up to the rank of classes. A study of the Myxomycetes, Plasmodiophoromycetes (*Plasmodiophora*), Chytridiomycetes (*Synchytrium*, *Allomyces*), Oomycetes (*Pythium, Phytophthora, Saprolegnia*), Zygomycetes (*Mucor*), Ascomycetes (*Taphrina, Claviceps, Morchella, Aspergillus*), Basidiomycetes (*Puccinia, Uromyces, Ustilago, Clavaria*) and Deuteromycetes (*Colletotricum, Alternaria, Fusarium*) with reference to: Classification up to the rank of orders; Range of structure and organization of vegetative and reproductive bodies; Ultrastructure; Method of reproduction; Variation in life- cycle; Economic importance.

Unit – II

Concept of plant disease, Classification of plant diseases. Pathogenesis and disease development; role of enzymes and toxins in pathogenesis. Plant disease diagnosis; Koch's postulates with special reference to parasitism. Host-pathogen interaction, Host defense mechanisms. Heterokaryosis, Parasexuality, Heterothallism, Hormonal control of sexual reproduction. Disease forecasting.

Unit – III

Green ear disease of bajra- *Sclerospora graminicola,* Damping off of seedling and fruit rot- *Pythium,* Stem gall of coriander- *Protomyces macrospores.* Peach leaf curl- *Taphrina deformans,* Ergot of rye- *Claviceps purpurea.* Rust of linseed- *Melampsora lini,* Rust of wheat- *Puccinia recondita, P. striiformis,* Covered smut of barley- *Ustilago hordei,* Loose smut of oats- *Ustilago avenae,* Mitosporic fungi and diseases- Leaf spot and shot holes- *Alternaria spp.,* Tikka disease of groundnut- *Cercospora spp.,* red rot of sugarcane- *Colletotrichum falcatum*, Diseases caused by nematodes-Ear cockle of wheat- *Anguina tritici*, Root knot of vegetables- *Meloidogyne incognita* and Abiotic/Non-pathogenic diseases- Black tip of mango, Black heart of potato.

Unit – IV

General account of lichen with special reference to: Habitat, Structure and organization of lichens, Method of reproduction. Physiological relationship of mycobiont and phycobiont, Economic importance of lichens; Mycorrhizae: General account, types and significance.

Suggested Readings:

- Introductory Mycology by Alexopoulos, Mims and Blackwell; John Wiley & Sons Publications, 1996.
- Text Book of Mycology by A.K. Sarbhoy; ICAR Publications, New Delhi, 2006.
- Plant Pathology by R.S. Mehrotra & A. Aggarwal; Tata McGraw-Hill Publishing, 1980.
- Plant Pathology by George N. Agrios; Academic Press, 1997.
- Protocols in Medicinal and Aromatic Plants by Shukla and Dikshit; Today and Tomorrow's Printers and Publisher, India, 2016.
- Introduction to Fungi, J. Webster and R. Weber, 2007, 3rd edition, Cambridge University Press.
- The Fungi, S.C. Watkinson, N.P. Money, L. Boddy, 3rd edition, Elsevier Science Publishing Co Inc.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

M.Sc. BOTANY (SEMESTER-I)

Paper-III

(Course Code: MBOT-103C)

ALGAE AND BRYOPHYTES

4 Credits/60 Lectures

Marks: 25+75

Student Learning Outcomes:

- The study will cover the fundamental ideas of algae growth. It will be used to boost agricultural productivity.
- The study is applicable to the production of biofertilizers.
- Students will be able learn about the evolutionary history and origins of bryophytes, as well as their ecological and economic value.
- Understand the phylogeny, evolution, origin, and fossil history of bryophytes.

Unit - I

General characteristics, life history pattern and alternation of generations, origin, evolution, classification by (Fritsch, Smith), modern trends for algal classifications (molecular and chemotaxonomy), Fossil algae, Algal blooms. Study of division Cyanophyta *(Microcystis*, *Oscillatoria*, *Nostoc*, *Spirulina*), Chlorophyta (*Volvox, Chlorella, Ulva, Cladophora, Fritschiella, Oedogonium, Zygnema, Codium, Chara*) and Xanthophyta (*Vaucheria*) with reference to the following: General features, Range of structure and organization of thallus, Reproductive diversity, pigments, reserve food products, Classification up to the level of order. Economic Importance of Algae.

Unit -II

Study of division Phaeophyta (*Ectocarpus, Dictyota, Laminaria, Sargassum*) and Rhodophyta (*Batrachospermum, Polysiphonia*) with reference to the following: General features, Range of structure and organization of thallus, Reproductive diversity and life cycle patterns, Classification up to the level of order. General characteristics of the divisions Prochlorophyta, Charophyta, Euglenophyta, Pyrrophyta, Bacillariophyta and Cryptophyta.

Unit -III

General characteristics, life cycle, Classification, Origin, Phylogeny, Fossil history of Bryophytes, Ecology, Physiology and Reproductive biology of bryophytes, Endemism and endemic liverwort genera of India, Spore diversity, dispersal and germination. Moss protonema, protonemal differentiation and bud induction, Moss peristome and their role.

Unit -IV

Characteristic features, criteria of classification and phylogeny, life history, range of gametophytic and sporophytic organization (morphology, anatomy and their distribution in India) in various orders: Takakiales (*Takakia*), Calobryales (*Haplomitrium* (*Calobryum*), Monocleales (*Monoclea*), Sphaerocarpales (*Sphaerocarpos*), Marchantiales (*Plagiochasma*, *Asterella*, *Lunularia*, *Dumortiera*, *Targionia*), Jungermanniales (*Jungermannia*, *Porella*), Anthocerotales (*Anthoceros, Notothylas*) Sphagnales (*Sphagnum*), Andreaeales (*Andreaea*) and Bryales (*Physcomitrium*, *Polytrichum*). Evolution of sporophyte by progressive sterilization of potential sporogenous tissue.

Suggested Readings:

- Phycology, 5th Ed., Robert Edward Lee, Publisher-Cambridge University Press, 2018.
- Introduction to the Algae, 2nd Ed., Bold and Wynne, 1984.
- Introductory Phycology, H. D. Kumar, 1990.
- Algae, 1st Ed, O. P. Sharma, 2011.
- Principles and Techniques of Biochemistry and Molecular Biology, 8th Ed., Wilson and Walker, 2018.
- Biology of Bryophytes. - R.N. Chopra and P.K. Kumra. New Age International (P) Limited, New Delhi 1988.
- An Introduction to Bryophyta. (Diversity, Development and Differentiation). – A. Rashid. Vikas Publication House Pvt. Ltd., 1998.
- Bryophytes – A Broad Perspective. - Prem Puri. Atma Ram & Sons, Delhi & Lucknow, 1985.
- Cryptogamic Botany. Bryophytes and Pteridophytes. Vol. II. G.M. Smith. Tata McGraw- Hill Publishing Company Limited, New Delhi, 1972.
- The Structure and Life of Bryophytes. – E.V. Watson, BI publications, 1964.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

M.Sc. BOTANY (SEMESTER-I)

Paper-IV

(Course Code: MBOT-104C)

PTERIDOPHYTA, GYMNOSPERMS AND PALAEOBOTANY

4 Credits/60 Lectures

Marks: 25+75

Student Learning Outcomes:

- To study first vascular land plants, naked seed plants and palaeological evidences.
- Students will be able to learn the diversity and adaptation of pteridophytes and gymnosperms during the long geological time periods.
- Have knowledge of major evolutionary trends in Pteridophytes viz. stelar and telome theory.
- The study will provide an insight to evolution and palaeological knowledge.
- Understand the evolutionary trends, geographical distribution, affinities and inter- relationships, morphology, anatomy and reproductive biology of fossil and living members of different groups of Gymnosperms.
- Students will learn the economic importance of pteridophytes and gymnosperms as this group includes highly medicinal plants.

Unit-I

Classification and origin of Pteridophytes; The vegetative sporophyte; Microphylls and megaphylls; Stelar theory; Telome theory; The fertile sporophyte: sporangia; position, ontogeny. Types, structure. Heterospory: Occurrence, causes and significance, seed habit. The gametophytes: Germination of fern spores, development of fern prothallus; Comparative study of Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

Unit-II

Classification of gymnosperms up to the rank of orders. General account of the following groups with special reference to the genera indicated in brackets: Pteridospermales (*Lyginopteridales,* Glossopteridales, Caytoniales), Bennettitales (*Williamsonia* sp.), Pentoxylales, Corditales.

Unit-III

General account of the following groups with special reference Morphology anatomy and reproduction in groups Cycadales, Ginkgoales (*Ginkgo biloba*), Coniferales, Ephedrales (*Ephedra* sp.) Gnetales (*Gnetum* sp.) and Welwitschiales (*Welwitschia* sp.)

Unit-IV

Principles of Palaeobotany and geological time scale; Process of fossilization and types of fossils; Methods of study of fossils and carbon dating technique; Molecular paleontology.

Suggested Readings:

- The Morphology of Pteridophytes, K.R. Sporne, Hutchinson & Co Publishers Ltd., 1962.
- An Introduction to Pteridophyta: Diversity and differentiation, A. Rashid, Vikas Publication House Pvt. Ltd., 1999.
- Cryptogamic Botany: Bryophytes and Pteridophytes, G.M. Smith, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1972.
- The Biology and Morphology of Pteridophytes N.S. Parihar, The Indian Universities Press Allahabad, 1965.
- Gymnosperms, S.P. Bhatnagar, A. Moitra, New Age International (P) Limited, 1996.
- An introduction to Gymnosperms, Cycas and Cycadales, Divya Darshan Pant, BSIP, 2002.
- Gymnosperms- Structure and Evolution, C. J. Chamberlain, CBS Publishers and Distributors, 1986.
- The Morphology of Gymnosperms, K.R. Sporne, Hutchinson & Co. (Publishers) Ltd, 1965.
- Botany for Degree Students, Vol. V- Gymnosperms, P.C. Vasishta, A.K. Sinha, A. Kumar, S. Chand & Co. Ltd., 1976.
- Gymnosperms- Extinct and Extant, C.M. Govil, Krishna Prakashan Media (P) Ltd, 2007.
- Embryology of Gymnosperm, Hardev Singh, Gebruder Borntraeger, Berlin, 1978.
- Gymnosperms of India and Adjacent Countries, K.C. Sahani, Bishen Singh
- Mahendra Pal Singh, 1990.
- Botanical Monograph No. I – *Gnetum*., P. Maheshwari and V. Vasil, CSIR, New Delhi, 1961.
- *Pinus*, P. Maheshwari and R.N. Konar, CSIR, New Delhi, 1971.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

M.Sc. BOTANY (SEMESTER-I)

Practical

(Course Code: MBOT-106P)

4 Credits

Marks: 25+75

"Practical based on core" (MBOT-101C to MBOT-104C)

Internal & External Assessment			
Internal Assessment	**Marks**	**External Assessment**	**Marks**
Class interaction	5	Viva Voce on Practical	10
Quiz & Seminar	5	Report on Botanical Excursion/ Lab Visits/Industrial training/ Survey/Collection/ Models	10
Assignments (Charts/ Flora/ Rural Service/ Technology Dissemination/ mini research work/Botanical Excursion/ Lab Visits/Industrial & laboratory training)	15	Table work / Experiments	45
		Practical Record File	10
TOTAL *Botanical Excursion/Minor research work/ Lab Visits/Industrial training is compulsory for semester I & III	**25**		**75**

M.Sc. BOTANY (SEMESTER-II)

Paper-I

(Course Code: MBOT-201C)

ANGIOSPERMS I: TAXONOMY AND BIOSYSTEMATICS

4 Credits/60 Lectures

Marks: 25+75

Student Learning Outcomes:

- Have an idea of the principles and relevance of different classification systems and their phylogenetic significance.
- Students will be able to understand the basics of plant collections, identification and nomenclature.
- Be well versed with the modern tools of taxonomy viz. morphological, anatomical, reproductive, cytological and chemical parameters.
- Become aware of the distinguishing taxonomic features and interrelationships of selected Dicot and Monocot families.

Unit-I

Principles of Systematics, Contribution of Ancient India in taxonomy and classification of Plants. Brief comparative study of the following System of Classifications:

a) Bentham and Hooker
b) Hutchinson
c) Takhtajan
d) Engler and Prantle

Unit-II

Basic concepts of Molecular Systematics: Angiosperm phylogeny groups (APG); Homology assessment, Phenetic and Cladistics methods. Botanical nomenclature: International code of nomenclature of Algae, Fungi and Plants (ICN); Principles: rules and recommendations; typification, priority, rules of effective and valid publications; Synonyms, Basionym, conservation of names.

Unit-III

Recent trends in taxonomy; Morphology, Anatomy, Cytology, Phytochemistry, Embryology, Palynology and Evolution of Angiosperms. Plant identification: Taxonomic keys, Field and Herbarium techniques: Plant Collection and Documentation: Methods of collecting plants; Herbarium Specimens preparations; Role of Botanic Gardens in conservation of biodiversity.

Unit-IV

Taxonomic features, systematic phylogeny and economic importance of families:

Dicotyledons: Magnoliaceae, Ranunculaceae, Papaveraceae, Anacardiaceae, Leguminosae, Rosaceae, Myrtaceae, Apiaceae, Rubiaceae, Solanaceae, Brassicaceae, Cucurbitaceae, Caryophyllaceae, Malvaceae, Asteraceae, Scrophulariaceae, Asclepiadaceae, Convolvulaceae, Bignoniaceae, Acanthaceae, Polygonaceae, Euphorbiaceae.

Monocotyledons: Amaryllidaceae, Araceae and Arecaceae, Zingiberaceae, Orchidaceae, Cyperaceae and Poaceae.

Suggested Readings:

- J. Harborne, B.L. Turner and D. Boulter- Chemotaxonomy of Leguminosae, Academic Press, London, 1971.
- John Firminger Duthie- Flora of Upper Gangetic Plains, Shiva offset Press, vol. I, 1903, vol. II, 1911.
- John Hutchinson- The Families of Flowering Plants, Clorendon Press, 1959.
- Arthur John Cronquist- The Evolution and Classification of Flowering Plants, Shiva offset Press, 1981.
- P.H. Davis and B.H. Heywood- Principles of Angiosperm Taxonomy, Princeton Press, 1963.
- Alfred Barton Randle- The Classification of Flowering Plants, Harvard University, 1904.
- Gurcharan Singh- Plant Systematic, Oxford & IBH Publishing Company Pvt. Ltd., 1999.
- Tod F. Stuessy-Plant Taxonomy, Shiva offset Press, 2002.
- Peter H.A. Sneath and Robert R. Sokal- Numerical Taxonomy, Wayne State University Press, 1973.
- T. Pullaiah- Taxonomy of Angiosperms, Regency Publications, New Delhi, 1998.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

M.Sc. BOTANY (SEMESTER-II)

Paper-II

(Course Code: MBOT-202C)

ANGIOSPERMS II: MORPHOLOGY, EMBRYOLOGY AND ANATOMY

4 Credits/60 Lectures

Marks: 25+75

Student Learning Outcomes:

- This course provides an opportunity to grasp the knowledge of cell development, regulation and *in vitro* fertilization for the improvement of crop varieties.
- Students will be able to learn interaction of growth regulators in developmental processes.
- To understand the concept of polyembryony and produce seedless fruits and can perform control of fertilization and different experiments of embryology in field.

Unit-I

Phylogeny of Angiosperms; Morphology of flower; Morphology of carpel and ontogeny of inferior Ovary.

Unit-II

Microsporogenesis, Megasporogenesis, Pollination, Pollen pistil interaction and double fertilization, Endosperm, Embryosac & it types and development of embryo. Self-incompatibility mechanisms; polarity during embryogenesis; somatic embryogenesis; apomixis, polyembryony and its induction, Induced parthenocarpy; in vitro pollen germination.

Unit-III

Primary meristem organization of shoot and root apices; Differentiation of cells: stomata, trichomes, tracheary elements etc.; Development of organs: organ identity, key regulatory mechanisms in development of size and shape of specific organs such as leaf, stem, shoot etc.

Unit-IV

Cambium and its derivative tissues, differentiation of secondary xylem and secondary phloem; Structure of wood in relation to its weight, strength and durability; Cork cambium and its derivatives, function of cork and abscission layers, Anatomy of floral organs.

Suggested Readings:

- Fahn (1967) Plant Anatomy, Pergamon Press
- A.J. Eames and L.H. Mac Daniels (1972) An Introduction to Plant Anatomy, Mc Graw Hill
- BM Johri (1984) Embryology of Angiosperms, Springer-Verlag, Berlin
- E.F. de Vogel (1980) Seedling of Dicotyledons, Centre for Agricultural Publishing and Documentation, Wageningen.
- E.W. Sinnott (1960) Plant Morphogenesis, McGraw-Hill Book Company, Inc. New York
- G. Erdtman (1952) Pollen Morphology and Plant Taxonomy-Angiosperms: An Introduction to

- Palynology I, The Chronica Botanica Comp. Waltham, Mass, USA
- K. Esau (1971) Anatomy of Seed Plants, John Wiley & Sons
- K. Ramesh Rao & KBS Juneja (1971) Field Identification of Fifty Important Timbers of India, FRI Publication
- P.K.K. Nair, Ed. (1980) Glimpses in Plant Research. Aspects of Reproductive Biology Vol VI
- S.S. Bhojwani, S.P. Bhatnagar, P.K. Dantu (2015) The Embryology of Angiosperms, Vikas Publishing House Pvt. Ltd., New Delhi, India.
- V. Raghavan (2000) Developmental Biology of Flowering Plants, Springer-Verlag, New York.
- V. Singh, P.C. Pande and D.K. Jain (1987) Anatomy of Seed Plants, Rastogi Publications, Meerut
- Y.V. Chadha (1994) Elements of Morphogenesis, Awasthi Associates, Allahabad, India.
- Phyto-morphology (Trends in Plant Sciences), Golden Jubilee Issue 2001.
- A.W. Wardlaw (1968). Morphogenesis in Plants: A contemporary Study, Methuen & Comp. Ltd.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

M.Sc. BOTANY (SEMESTER-II)

Paper-III

(Course Code: MBOT-203C)

CYTOLOGY AND GENETICS

4 Credits/60 Lectures

Marks: 25+75

Student Learning Outcomes:

- The knowledge of cell and its organelles will provide an insight into drug development processes.
- Students will be able to learn the techniques related to cytological analysis.
- Understand different mechanisms of inheritance, including Mendelian and non-Mendelian systems.
- Learn about the regulatory mechanisms for gene expression in the cell, along with a detailed conceptualization of the cell cycle, genetic code and apoptosis.
- To understand the concept of tumor formation and its control.

Unit-I

Ultra-microscopic structure of Plant Cell, Ultrastructure of Plant cell wall. Ultrastructure and Function of Biological Membranes. Chloroplast and Mitochondria. Plasmodesmata, Nucleus and nuclear pore complex (NPC). Biochemical composition and ultrastructure of chromosome and chromatin, Special types of chromosomes, Chromosomal aberrations.

Unit-II

Cytoskeleton: microtubules, microfilaments, and intermediate filaments. Cell signaling: cell surface receptors, G-protein, GPCRs, second messengers, membrane derived messengers, serine/threonine kinases and receptor tyrosine kinases (RTKs), Ca^{+}-calmodulin-dependent protein kinases (CaM kinases), MAPK cascade. **Cell division:** Cell cycle, control of cell division cycle, spindle organization, uncontrolled cell division, apoptosis in plant cell.

Unit-III

Concept of gene, allele, multiple alleles, pseudo allele, complementation test, extensions of Mendelian principles: gene interaction, genomic imprinting, Extra chromosomal inheritance.

Unit-IV

Quantitative inheritance, QTL mapping, population genetics, factors responsible for changes in allele frequency, Hardly-Weinberg equilibrium (HWE), genetic drift, speciation, and adaptive radiation.

Suggested Readings:

- Lewin's GENES XII, 12th edition- by Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick, Cenveo Publishers, 2018.
- Molecular Biology of the Gene- by James D. Watson, A. Baker Tania, P. Bell Stephen, Gann Alexander, Dorling Kindelay, 2006.
- Principles of Genetics- by Gardner, Simmons, Snustad, Replica Press, 1984.
- Molecular Biology of the Cell, 6th edition- by Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Garland Science, 2015.
- I Genetics: A Mendelian Approach- by Peter J Russell, Pearson, 2010.
- Keith Wilson and John Walkers Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, 1975.
- Molecular Cell Biology- by Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Mathew P. Scott, Anthony, Brest Cher, Hidde Ploegh, Paul Matsudaira, W.H. Freeman & company, 1986.
- Genetics: A Conceptual Approach- by Benjamin A. Pierce, W.H. Freeman & company, 2003.
- Genetics: Analysis of Genes and Genomes- by Daniel L. Hartl, Elizabeth W. Jones, Jones & Bartlett publishers, 2001.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

M.Sc. BOTANY (SEMESTER-II)

Paper-IV

(Course Code: MBOT-204C)

SOIL SCIENCE AND PHYTOGEOGRAPHY

4 Credits/60 Lectures

Marks: 25+75

Student Learning Outcomes:

- Students will learn the different physical and chemical properties of Soil.
- Learn how to increase soil fertility and overview of decomposition and release of nutrients.
- Have knowledge of soil types and their properties along with method of soil formation.
- To test soil pH and help in agricultural crops.
- Have clear concept of phytogeographical distribution of plants.

Unit-I

The nature of parent material and development of soil; Major process of soil formation: Calcification, Podzolization and Laterization; Physical properties: Particle system, structure of soil; soil moisture constants, soil aeration, pF scale.

Unit-II

Chemical properties: Soil solution and nutrients, soil pH, Cation exchange phenomenon, redox potential, acidity, alkalinity, and salinity of soils; Soil organisms; organic matter, over view of decomposition, Process of humification and mineralization, recycle index, decomposition and release of nutrients, Reclamation of usar soil.

Unit-III

Phytogeography: Biogeographic divisions; major terrestrial biomes, Vegetation types and Phytogeographical regions of India; theory of island biogeography.

Unit-IV

Endemism, Indian endemic flora; Exotics and Alien flora. Hotspots and hottest hotspots of biodiversity; Distribution of plant species, Dispersal and routes of dispersal.

Suggested Readings:

- The nature and properties of soils, Nyle C. Brady and Ray R. Weil, Pearson Education Pvt. Ltd., 2002
- Environmental Science, Richard T. Wright and Bernard J. Nebel, Prentice Hall India Pvt. Ltd., 2002
- Encyclopedia of Ecology, Environment and Pollution Control, R. Swarup, S.N. Mishra, V.P. Jauhari, Mittal Publication, New Delhi, 1999
- Natural Resource Conservation, 10th edition, Daniel D. Ohiras, Pearson Publication, 2019
- Environmental Science, S.C. Santra, New Central Book Agency Pvt. Ltd., 2001
- Fundamentals of Ecology, 3rd edition, E.P. Odum, Natraj Publication, 1971

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

M.Sc. BOTANY (SEMESTER-II)

(Practical)

(Course Code: MBOT-206P)

4 Credits

Marks: 25+75

"Practical based on core" (MBOT-201C to MBOT-204C)

Internal & External Assessment			
Internal Assessment	**Marks**	**External Assessment**	**Marks**
Class interaction	5	Viva Voce on Practical	10
Quiz & Seminar	5	Report on Botanical Excursion/ Lab Visits/Industrial training/ Survey/Collection/ Models	10
Assignments (Charts/ Flora/ Rural Service/ Technology Dissemination/ mini research work/Botanical Excursion/ Lab Visits/Industrial & laboratory training)	15	Table work / Experiments	45
		Practical Record File	10
TOTAL *Botanical Excursion/ Minor research work/ Lab Visits/Industrial training is compulsory for semester I & III	**25**		**75**

M.Sc. BOTANY (SEMESTER-III)

Paper-I

(Course Code: MBOT-301C)

PLANT BIOCHEMISTRY

4 Credits/60 Lectures

Marks: 25+75

Student Learning Outcomes:

- The paper will provide an opportunity to develop an understanding of biomolecules, types, interactions and mechanism of biological catalysts.
- The understanding of biochemical techniques will prepare students to isolate potential biomolecules.
- To understand the role of vitamins and its role in metabolism in plants.

Unit-1

Composition, Structure and functions of carbohydrates, lipids and proteins. Stabilizing interactions (Vander Waals, electrostatic, hydrogen bonding and hydrophobic interactions etc.) Conformation of proteins, Secondary structure, domains and motif. Peptide bond, Ramchandran Plot.

Unit-2

Enzymes: Regulatory and active sites, activation energy, isozymes, Principles of catalysis, kinetics of enzymatic catalysis, Michaelis-Menten equation, its derivation and significance.

Coenzymes: Structure and classification of coenzymes, Prosthetic group and cofactors; role of vitamins as coenzymes. Allosteric enzymes, Ribozymes, abzymes, and Enzyme regulation.

Unit-3

Bioenergetics: Laws of thermodynamics and its application in biological systems, concept of entropy and enthalpy, concept of free energy, energy rich bonds and high energy compounds, energetic coupling. Substrate level phosphorylation.

Unit-4

Biochemical techniques: Different types of chromatographic techniques, based on ion exchange and affinity, electrophoresis and electro focussing, centrifugation: ultracentrifugation and density gradient centrifugation, Spectrophotometry.

Suggested Readings:

- Wilson, K. and Walker, J., 2000, Practical Biochemistry: principles & techniques. Cambridge University Press. ISBN 0521799651.
- Buchanan, B., Gruissem, W., & Jones, R.L., 2002, Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists, USA.
- Watson, JD, Baker, TA, Bell, SP, Gann, A, Levine, M and Richard, L. 2008. Molecular Biology of the Gene. Pearson Education Inc.
- Nelson, D.L. and Cox, M.M., 2008, Lehninger Principles of Biochemistry, W. H. Freeman & Co, New York, USA.

- Murray, R, Murray, RK, Bender, D, Gotham, KM, Kennelly, PJ, Rodwell, V and Weil, PA. 2012. Harper's Illustrated Biochemistry McGraw Hill
- Wilhelm Gruissem, Russell L. Jones, 2000, Biochemistry and molecular biology of plants. American Society of Plant Physiologists,
- Berg, J.M., Tymoczko, J.L. & Stryer, L. 2011, Biochemistry, Freeman & Co., New York, USA.
- Weil, J.H., 1990, General Biochemistry, Wiley Eastern Limited, New Age International Limited. New Delhi.
- Lea P.J. and Leegood R.C., 1999, Plant Biochemistry & Molecular Biology, John Wiley & Sons, New York.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

M.Sc. BOTANY (SEMESTER-III)

Paper-II

(Course Code: MBOT-302C)

PLANT PHYSIOLOGY

4 Credits/60 Lectures

Marks: 25+75

Student Learning Outcomes:

- The students will be able to learn role of growth regulators in plant development.
- Carbon assimilation is a process related to biomass accumulation. Students will learn the factors related to carbon assimilation and processes that regulate it.
- To understand the concept of flowering and understand role of hormones.

Unit-1

Photochemistry and Photosynthesis: Photosynthetic pigments and light harvesting complexes, photo-oxidation of water, Q-cycle: mechanism of electron and proton transport. Carbon assimilation: regulation of Calvin cycle; photorespiration and its significance, the C_3, $C_4$and CAM pathways.

Soil and plant water relationship: structure and properties of water, water transport processes. Water balance of plants: water transport through the xylem, water movement from the leaf to the atmosphere. Stomatal physiology.

Unit-2

Translocation in the phloem: pathways of translocation, the pressure-flow model for phloem transport. Mechanism of phloem loading and unloading

Respiration: Glycolysis, TCA cycle, electron transport in plant mitochondria and ATP synthesis, pentose phosphate pathway.

Secondary metabolites: structure, and biosynthesis of terpenes, alkaloids, and phenolic compounds, their role in plant Défense and industrial uses.

Unit-3

Plant Growth Regulators: structure, biosynthesis, and storage, break down and transport. Physiological effects and molecular mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, jasmonates, salicylic acid and strigolactones.

Stress physiology: Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

Unit-4

Physiology of floral induction: photoperiodism, genome reprogramming during flowering. Molecular mechanism of flowering in long day plant (*Arabidopsis thaliana*) and short-day plant (rice: *Oryza sativa*). Vernalization: epigenetic modification during vernalization. Homeotic genes, quartet (ABCE) model of flowering.

Sensory Photobiology: history, discovery, photochemical properties and photophysiology of light induced responses by the photoreceptors: phytochromes, cryptochromes, phototropins, UVR-8 and zeitlupe (ZTL).

Suggested Readings:

- Taiz and Zeiger, 2010, Plant Physiology, 5th Edition, Sinurer Associates
- Hopkins, W.G. and Huner N.P.A., 2009, Introduction to Plant Physiology, 4th Edition Wiley International Edition, John Wiley & Sons, USA
- Jones, Russell L. Buchanan, Bob B. Guissem, Wilhelm., 2002, Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists.
- Peter Scott, Physiology and Behaviour of Plants. Wiley-Blackwell.
- Frank Boyer Salisbury and Cleon Ross, 1991, Plant Physiology, CA.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

M.Sc. BOTANY (SEMESTER-III)
Paper-III
(Course Code: MBOT-303C)
PLANT ECOLOGY
4 Credits/60 Lectures
Marks: 25+75

Student Learning Outcomes:

- Students will learn about different ecosystems; plant communities and other important aspects related to biodiversity.
- Conservation of our forests
- To understand the concept of energy flow in different ecosystems.

Unit-1

Concept and Scope of Ecology: Collective, and Emergent properties, Habitat and niche: multidimensional niche, fundamental and realized niche, resource partitioning, character displacement.

Unit-2

Population Ecology: Natality, mortality, survivorship growth rates of population, growth curve; biotic potential, carrying capacity and environmental resistance; population interactions, competition-coexistence models, concept of meta-population, life history strategies (r and K selection).

Unit-3

Community Ecology: Bioenergetics of Ecological succession, type of succession Climax theories; Analytical and Synthetic characters of community, biodiversity status, major drivers of biodiversity change, levels of species diversity and measurement, indices of diversity; diversity and stability of ecosystem, edges and ecotones. Species interactions and coevolution.

Unit-4

Ecosystem Ecology: Concept of ecosystem, its structure and function, trophic structure, food chain energy flow, overview of production and decomposition, Sulphur and phosphorous biogeochemical cycles, Ecosystem services, restoration ecology, components of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (freshwater, marine and estuarine).

Suggested readings:

- Odum, E. P. and Barret G.W. 2005. Fundamentals of Ecology. Cengage publication.
- Odum, E.P., 1983. Basic Ecology., Saunders College Publishing.
- Singh, J.S., Singh S.P. and Gupta S.R. 2006. Ecology Environment and Resource Conservation. Anamaya Publishers.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

M.Sc. BOTANY (SEMESTER-III)

Paper-IV

(Course Code: MBOT-304C)

CYTOGENETICS, PLANT BREEDING AND BIOSTATISTICS

4 Credits/60 Lectures

Marks: 25+75

Student Learning Outcomes:

- The cytological knowledge of genetics will provide an opportunity to develop new crop varieties.
- Knowledge of plant breeding will help to improve crop varieties by plant introduction, mutation breeding and utilize other techniques of hybridization for crop improvement.
- Student with learn sampling of complex data.
- Student will learn analysis of variance and data computation.
- Student will learn correlation of various data in biological sciences.
- The students will be able to apply the concept of the biostatistics in their research work.

Unit-1

Structural Changes in Chromosomes: Deletion, duplication, inversion (paracentric and pericentric), and translocation: cytology, genetics and their role in genome evolution. Robertsonian Translocation. Numerical changes in chromosomes: Aneuploidy and Euploidy-cytology and genetics, their role in crop improvement.

Unit-2

Introduction to plant breeding; Domestication; plant introduction and acclimatization, kinds of germplasm, Methods of selection and hybridization; Techniques of selfing and crossing. Cytoplasmic male sterility; Heterosis and hybrid seed production; Mutant breeding; Polyploidy in plant breeding; Breeding for nutritional quality. Experimental designs in plant breeding: randomized block design (RBD), completely randomized designs (CRD), Latin square design (LSD), split plot design (SPD), lattice design (LD), and augmented design (AD).

Unit-3

Measures of central tendency: Mean, Median and Mode; Measures of dispersion: Standard deviation, Standard error, Mean deviation. Analysis of variance. Correlation and regression: statistical hypothesis, null hypothesis, two types of error, statistical significance, parametric and nonparametric hypotheses, critical region, level of significance.

Unit-4

Practical application of simple test of significance viz.,'t'- test and 'F'- test, Chi-square (X^2) test as a goodness of fit, conditions for application of X^2 test. Elementary idea of probability, combination and permutations, continues and discontinuous variables.

Suggested readings:

- Clark, M.S. and Wall, W.J. 1996, Chromosomes: The Complex Code. Chapman & Hall, London.
- Stebbins, G.L.1950, Variation and Evolution in Plants. Columbia Univ. Press, New York.
- Swanson, C. P., Mertz, T.F. and Young, W.J. Cytogenetics: The Chromosomes in Division, Inheritance and Evolution (2nd Edn). Englewood Cliff, Prentice-Hall, New Jersey.
- Sharma, A.K. and Sharma, Archana. 1985. Advances in Chromosome and Cell Genetics. Oxford & IBH Publishing Co., Calcutta.
- Schnedl, W. Banding patterns in chromosomes. In: International Review of Cytology (Suppl. 4).
- Lewine, Benjamin, Jones and Bartlet, Genes X, Sudburry, Masschusetts
- Gupta, P.K., Cytogenetics, Rastogi Publication, Meerut
- Peter, D, Snustand and Simmons, M.J., John Wiley and Sons Inc.
- Plant Breeding Principal & Methods, B.D. Singh, Kalyani Publishers, 1983.
- Plant Breeding, V. Kumaresan, Saras Publication, 2015.
- Fundamentals of Plant Breeding, Phundan Singh, Kalyani Publishers, 2017.
- Plant Breeding: Scholar Select, Liberty Hyde Bailey, Arthur Witter Gilbert, 2018.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

M.Sc. BOTANY (SEMESTER-III)

Practical

(Course Code: MBOT-305P)

4 Credits

Marks: 25+75

"Practical based on core" (MBOT-301C to MBOT-304C)

Internal & External Assessment			
Internal Assessment	**Marks**	**External Assessment**	**Marks**
Class interaction	5	Viva Voce on Practical	10
Quiz & Seminar	5	Report on Botanical Excursion/ Lab Visits/Industrial training/ Survey/Collection/ Models	10
Assignments (Charts/ Flora/ Rural Service/ Technology Dissemination/ mini research work/Botanical Excursion/ Lab Visits/Industrial & laboratory training)	15	Table work / Experiments	45
		Practical Record File	10
TOTAL	**25**		**75**

M.Sc. BOTANY (SEMESTER-III)

INDUSTRIAL TRAINING/SURVEY/RESEARCH PROJECT

(Course Code: MBOT-306R)

4 Credits

Marks: 100

M.Sc. BOTANY (SEMESTER-IV)

Paper-I

(Course Code: MBOT-401C)

MOLECULAR BIOLOGY AND BIOTECHNOLOGY

4 Credits/60 Lectures

Marks: 25+75

Student Learning Outcomes:

- Students will be able to learn biotechnological concepts of crop improvement, tolerance, and resistance.
- Development of new transgenics.
- Use of Mutation in plant improvement and its yield.

Unit-1

Nucleic acids: Structure and form of DNA, Circular DNA in bacteria and chloroplast, packaging of DNA, DNA melting (Tm), DNA annealing Cot curves, Genome complexity (unique, moderately repetitive, and highly repetitive or satellite DNA) C-value and C-value paradox.

Gene Replication: DNA replication in prokaryotes and eukaryotes (initiation, elongation, termination and regulation), fidelity of replication.

Unit-2

Gene Mutation: Mutagenic agents, mechanisms of mutagenesis, DNA damage and repair mechanism, uses of mutation.

Genetic Code: Codon assignment, code in mitochondria, initiation and termination codons.

Unit-3

Gene Expression: Mechanism of transcription and translation in prokaryotes and eukaryotes (initiation, elongation and termination), transcription activators and repressors. Post transcriptional modifications and RNA transport, translational proof reading, translational inhibitors, post translational modification of proteins.

Regulation of Gene Expression: Concept of operon, *lac* operon in detail, *trp* operon, attenuation, role of chromatin in gene regulation, gene silencing: miRNA and siRNA.

Unit-4

Genetic Engineering: Enzymes and vectors *viz.,* plasmids, phages, cosmids, BAC, YAC and *Agrobacterium tumefaciens,* gene cloning; Methods of gene transfer in plants. Transgenic plants and its application.

Tissue and Organ Culture: Micropropagation somaclonal variation, haploid production, protoplast culture and somatic hybridization. Application of Tissue culture in modern era.

Application of Biotechnology in agriculture: Disease resistance, pesticide resistance, abiotic stress tolerance and production of useful products and secondary metabolites.

Suggested readings:

- Buchanan, B., Gruissem, W., & Jones, R.L., 2002, Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists, USA.
- Bourton E. Tropp, Molecular Biology, 4th Ed., Jones & Barlett learning.
- Brown, T.A., DNA Cloning and Gene Sequencing Willey-Blackwell, Oxford
- Genes IX by Benjamin Lewin, Jones and Barlett.
- Y Gerald Karp, Cell and Molecular Biology 6th Ed., John Willey & Sons
- Nelson, D.L. and Cox, M.M., 2008, Lehninger Principles of Biochemistry, Fifth Edition, W. H. Freeman & Co, New York, USA.
- Cooper, G.M. and Robert, E. Hausman The Cell: A Molecular Approach 5th Ed. (Co-published by ASM Press and Sinaurer Assoc. Inc.)
- Watson, JD, Baker, TA, Bell, SP, Gann, A, Levine, M and Richard, L. 2008. Molecular Biology of the Gene. Pearson Education Inc.
- Introduction to plant biotechnology by H S Chawla.
- Elements of biotechnology by P K Gupta.
- S H Mantell, *et. al.*by Principles of Plant Biotechnology: An introduction to genetic engineering in plants.
- Plant Biotechnology by B. D. Singh, Kalyani Publications.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

M.Sc. BOTANY (SEMESTER-IV)

Paper-II

(Course Code: MBOT-402C)

PLANT RESOURCE UTILIZATION AND CONSERVATION

4 Credits/60 Lectures

Marks: 25+75

Student Learning Outcomes:

- This course work provides knowledge, utilization and their conservation with practical application.
- It opens the areas of plant-based industries like food industry, pharmaceutical industry and their bioprospection for nature and ecological services.
- This course will enable the students to know about different agencies involved in research and development of plant genetic resources.

Unit-1

Plant biodiversity for Man and their importance; History, Botany, cultivation and processing of: Cereals (Wheat, Rice, Maize), Legumes and Pulses, Forage crops, Fiber plants and their products.

Unit-2

Medicinal plants, Drugs and narcotics, Fumitories and masticatories, Beverage yielding plants, Important wood and timber yielding plants, Sugar and sugar yielding plants, Tropical and subtropical fruits.

Unit-3

Spices and flavoring materials, Vegetables, Gum and dye yielding plants, Latex yielding plants, teal coffee, rubber and Insecticide yielding plants. Origin of cultivated plants: center of origin, criteria and Vavilov's center of origin. Origin and cultivation of wheat, rice, maize, sugarcane, mustard and potato.

Unit-4

Principles of conservation; In situ conservation: Sanctuaries, national parks, biosphere resaves, wet lands, mangroves and coral reef, *Ex- situ* conservation: principles and practices, National seed corporation (NSC), Botanic gardens, role and impact of NSC, botanical survey of India (BSI), NBPGR (National Bureau of plant Genetics Resource), ICAR (Indian Council of Agriculture Research), Council of Scientific and Industrial Research (CSIR), Department of Science and Technology (DST) and Department of Biotechnology (DBT) and Germplasm conservation.

Suggested readings:

- Kochhar S. (2016) Economic Botany: A Comprehensive Study. Cambridge University Press. doi:10.1017/9781316286098.003
- Hill Albert F. (1937) Economic Botany. Mcgraw-Hill Publications.
- Singh, D.K., Ahmed H., Pathak, J. (2023). "Economic Botany, Ethnomedicine and Phytochemistry". Pragati Prakashan, Meerut. ISBN:978-93-5531-762-9.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

BOTANY SEMESTER-IV
Special Elective Paper- I ((MBOT-403E)
(A)-ADVANCE PLANT PATHOLOGY
4 Credits/60 Lectures
Marks: 25+75

Student Learning Outcomes:

- Students will get an idea about major plant diseases of cash crops in India.
- The course discusses major aspects of pathogens, epidemic, disease forecasting, and quarantine rules.
- Students will learn details of various aspects of plant disease control and management.

Unit-1

Study of role of modern molecular technological tools in Plant Pathology- Basic concepts and principles of host pathogen relationship. Basis concept of pathogenesis. Effect of environment on development of infectious disease of plants: Epidemiology. Plant disease forecasting, Transmission and symptoms of plant diseases in general. Major plant pathology centres/institutes.

Unit-2

Methods of study of infectious diseases of plants: isolation of pathogens and tests of pathogenicity. Principles and methods of plant disease control. Control through regulatory methods: Plant quarantine. Cultural and biological methods of control. Control through physical means. Chemical method for plant disease control: Fungicides, chemotherapy. Use of resistant varieties.

Unit-3

Molecular basis of host-pathogen interaction- fungi, bacteria viruses and phytoplasma; recognition system, signal transduction. Biotechnology and disease management; development of disease resistance plants using genetic engineering approaches, gene-for-gene hypothesis; R-gene expression and transcription profiling, mapping and cloning of resistance genes and marker aided selection.

Unit-4

Study of importance, symptoms, causal organism, disease cycle and control of following diseases of crop plants in Uttar Pradesh: Damping off of seedlings of crop plants. Downy mildews of cucurbits. Rust of Barley. Powdery mildew of pea. Smuts and Bunts: Covered smut of Barley; loose smut of wheat and Bunt of rice. Wilt of sugarcane. Leaf spots: leaf spot of turmeric; Leaf blight of wheat. Blast disease of rice. Galls and other abnormalities: stem gall of coriander, leaf curl of Peach. Bacterial diseases: Citrus canker and Tundu disease of wheat. Viral diseases: Mosaics of tobacco, papaya, potato and Tungro of rice. Phytoplasmal diseases: Grassy shoot of sugarcane. Nematode diseases: Ear cockle of wheat.

Suggested readings:

- Webster, John, 1980, Introduction to Fungi, Cambridge University Press.
- Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996, Introductory Mycology, Wiley
- Carlile, M.J., Watkinson S.C. and Booday, G.W., 2001, The Fungi, Academic Press.
- Deacon, J.W., Blackwell, M, 1997, Introduction to Modern Mycology, Oxford
- Webster, John and Roland, W.S., 2007, Introduction to Fungi, Cambridge University Press.
- Hale, M.E. (1983), The biology of lichens (3rd ed.). Edward Arnold.
- Hawksworth, DL & Hill, DJ 1984: The Lichen-Forming Fungi. - Blackie, Glasgow and London. 158 pp
- Galun, M. (ed.) (1988) CRC Handbook of Lichenology. Volume III. - CRC Press, Inc., Boca Raton
- Brown D. H., Hawksworth D. L. & Bailey R. H. 1976, Lichenology: Progress & problems, Academic Press. London.
- Willey, J.M., Sherwood, L., Woolverton, C.J., 2010. Prescott's Microbiology. 8th edition, McGraw-Hill.
- Agrios, G. N., 1988. Plant Pathology, Academic Press.
- John A Lucas, 1998. Plant Pathology and Plant Pathogens, Wiley-Blackwell, CRC Press.
- Dickinson, C. M., 2003. Molecular Plant Pathology, Bios Scientific Publisher
- Bridge, P.D and Clarkson, J.M., 1998. Molecular Variability of Fungal Pathogens, CAB, International
- Singh, R. S., 2008. Principles of Plant Pathology, Oxford and IBH Publishing Co. Pvt Ltd.
- Dhingra, O.D. and James, B. Sinclair, 1995. Basic Plant Pathology Methods, CRC Press
- Pelczar, JM, Chan, ECS and Krieg, MR. 1993. Microbiology. Tata McGraw Hill.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

BOTANY SEMESTER-IV
Special Elective Paper- II (MBOT-403E)
(B) - ADVANCE PLANT TAXONOMY
4 Credits/60 Lectures
Marks: 25+75

Student Learning Outcome

- Students will be able to learn the basics of plant systematic, developmental and evolutionary studies.
- They will be able to explore the floristic diversity of the country.
- To understand how to make monographs and herbaria of our area.
- To understand ex-situ conservation of plants.

Unit-1

Plant Systematics: Taxonomic History and outline of various system of classification; Concept of Taxa; Botanical Nomenclature and type concepts; Citation of authors; Priority of Publication; retention and choice of names; naming a new species; Name changes; Synonyms and Basionyms. Botanical keys, their uses and construction.

Unit-2

Floristics and monographs; Taxonomic literature; Botanical Collections. Flora of Uttar Pradesh; Role of micromorphology in plant taxonomy; Centres of taxonomic work in India.

Ethnobotany and Traditional Knowledge: Concept, history, importance of ethnobotany and development of Ethnobotany in India.

Unit-3

Phylogenetic systematics: Phylogenetic data analysis, DNA barcoding and its practical implications. Application of DNA markers in angiosperm taxonomy.

Unit-4

Introduction to GIS and Remote Sensing, its applications in vegetation pattern analysis. Concept of biodiversity and conservation strategies.

Suggested readings:

- Sambamurty, A.V. S. S. 2005. *Taxonomy of Angiosperms*. I. K. International Pvt. Ltd., New Delhi.
- APG III 2009. An update of the Angiosperm Phylogeny Group Classification for the Orders and Families of Flowering Plants: APG III. *Bot. J. Linn. Soc.* 161: 105-121.

- Bhattacharyya, B. and B. M. Johri. 1998. Flowering Plants - Taxonomy and Phylogeny. Narosa Publishing House, New Delhi.
- Heywood, V. H. and Moore, D. M. 1984. Current Concepts in Plant Taxonomy. Oxford University Press.
- Duthie, J. F. "*Flora of Upper Gangetic Plain and of the adjacent Siwalik & sub-himalayan tracts*," Calcutta, Vol. 3, No. 1, 1915.
- Sharma, O. P. 1993. *Plant Taxonomy*. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- Stace, C. A. 1989. Plant Taxonomy and Biosystematics. University Park Place, Baltimore (2nd edn.)
- Takhtajan A. 2009. *Diversity and classification of flowering plants*, 2nd edn. Berlin: Springer.
- Verma, B.K. 2010. *An introduction to Taxonomy of Angiosperms*. PHI Learning Pvt. Ltd. New Delhi.
- Jones, S.B. Jr. and Luchsinger, AE. 1986. Plant Systematics (2nd edition). McGraw Hill Book Co., New York.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

BOTANY SEMESTER-IV
Special Elective Paper- III (MBOT-403E)
(C)-ADVANCE PLANT PHYSIOLOGY
4 Credits/60 Lectures
Marks: 25+75

Student Learning Outcome

- Students will learn in detail aspects of nitrogen metabolism.
- Production of Secondary metabolites, seed and stress physiology.
- Production and conservation of seeds.

Unit-1

Plant life: Cell architecture, The seed plant body plan (Epidermis, ground tissue and vascular system; Form and function of organ systems; Growth and development of new organs), Genome organization and expression, Molecules, metabolism and energy.

Germination: Seed to seedling: germination and mobilization of food reserves; Metabolism of reserves: respiration and gluconeogenesis, Control and integration of respiratory carbon metabolism; Translocation in phloem, Transpiration and its signification, Ascent of sap.

Unit-2

Emergence: Light perception and transduction (Phytochrome, Physiological responses to blue and ultraviolet light, Circadian and photoperiodic control), Photosynthesis (Photosystem II and the oxygen-evolving complex, Light reaction and carbon reaction; Photorespiration); Photosynthesis: Physiological and ecological consideration, Stomatal Biology.

Unit-3

Growth and development: Phyto-hormones and other signals, Cell origins and growth, Embryogenesis, Growth and differentiation of roots and leaves, Induction of flowering, Seed and fruit development.

Unit-4

Plant-environment Interaction: Responses to abiotic stresses (water, light, temperature, salinity); Responses to biotic stresses (systematic acquired resistance, A range of generic local and systemic stress responses are invoked by herbivory, predation and wounding), Senescence, ripening and cell death, Environmental influences on programmed senescence and death.

Suggested readings:

- Taiz and Zeiger, 2010, Plant Physiology, 5th Edition, Sinurer Associates.
- Hopkins, W.G. and Huner N.P.A., 2009, Introduction to Plant Physiology, 4th Edition Wiley International Edition, John Wiley & Sons, USA

- Jones, Russell L. Buchanan, Bob B. Guissem, Wilhelm., 2002, Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists.
- Peter Scott, Physiology and Behaviour of Plants. Wiley-Blackwell.
- Frank Boyer Salisbury and Cleon Ross, 1991, Plant Physiology, CA.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

BOTANY SEMESTER-IV
Special Elective Paper- IV(MBOT-403E)
(D)-FOREST ECOLOGY
4 Credits/60 Lectures
Marks: 25+75

Student Learning:

- Students will get detail idea of advanced aspect of forest ecology viz. forest types of India, forest ecosystem, reproductive strategies of tropical trees.
- Detailed study of forest and grassland soil.
- Effects of deforestation on community and nation at large.
- Cycling of nutrients

Unit-1

Ecology – definition and concepts; mass and energy flows through ecological systems; Ecological indicators; Communities, populations, groups and individuals; Population ecology. Overview of ecological classification of flora and fauna; classification, distribution and status of forest in India with emphasis on Champion and Seth classification. Measurement of diversity and diversity indices, Forest mensuration.

Unit-2

Structure of forest ecosystem: biotic and abiotic factors; ecosystems, components of ecosystem, deserts, cold and hot deserts, grasslands, tidal forests, wetlands forest ecosystem services and management. Photosynthetic efficiency; leaf area and growth. Nutrient cycling in tropical forest ecosystems.

Unit-3

Reproductive strategy of tropical trees; Natural and artificial regeneration; Ecological succession, kinds of succession; climax- mono-climax and poly-climax theories, Factors destructive to forest ecosystems; causes and effects of deforestation; systems; Invasive alien species (IAS): status of major forest IAS in India; effectiveness of management response to propagation and abundance of IAS; global advances in dealing with IAS; Role of trees in combating air pollution.

Unit-4

Physico-chemical properties of forest soil; ecological significance of soil texture; soil biology and soil fertility; Comparison of forest and grassland. Accumulation and decomposition of forest litter; forest humus; the geochemical, biogeochemical cycling of nutrients.

Suggested readings:

- Odum, E. P. and Barret G.W. 2005. Fundamentals of Ecology. Cengage publication.
- Odum, E.P., 1983. Basic Ecology., Saunders College Publishing.
- Singh, J.S., Singh S.P. and Gupta S.R. 2006. Ecology Environment and Resource Conservation. Anamaya Publishers.
- Champion, Sir H.G. and Seth, S.K. 1968. A Revised Survey of the Forest Types of India.

The internal 25 marks are based on:

Sr. No.	Types of evaluation	Marks
1.	Class Attendance	05
2.	Class Test/Assignment	10
3.	Quiz/Seminar	10
	Total	**25**

M.Sc. BOTANY (SEMESTER-IV)

Practical

(Course Code: MBOT-404P)

4 Credits

Marks: 25+75

"Practical based on core" (MBOT-401C to MBOT-402C)

Internal & External Assessment			
Internal Assessment	**Marks**	**External Assessment**	**Marks**
Class interaction	5	Viva Voce on Practical	10
Quiz & Seminar	5	Report on Botanical Excursion/ Lab Visits/Industrial training/ Survey/Collection/ Models	10
Assignments (Charts/ Flora/ Rural Service/ Technology Dissemination/ mini research work/Botanical Excursion/ Lab Visits/Industrial & laboratory training)	15	Table work / Experiments	45
		Practical Record File	10
TOTAL	**25**		**75**

M.Sc. BOTANY (SEMESTER-IV)

DISSERTATION AND VIVA-VOCE

(Course Code: MBOT-405D)

8 Credits

Marks: 100

Dr. Rekha Sharma (Convener)

Dr. Shiv Mahendra Singh

Dr. Deepak Kumar Singh

Prof. Anil Kumar Dwivedi

Prof. N.K Singh

Dr. Ashutosh Kumar Verma

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