S. S. Jain Subodh P.G. (Autonomous) College, Jaipur

(Affiliated to the University of Rajasthan)

SYLLABUS

TWO-YEAR POSTGRADUATE PROGRAMME IN SCIENCE
(Choice Based Credit System)

Master of Science

DEPARTMENT OF BOTANY

I & II SEMESTER EXAMINATION 2023-24

III & IV SEMESTER EXAMINATION 2024-25

(W.e.f. -2023)

1. Eligibility

M.Sc.

10+2+3 with 55% from any recognized University in Science Stream in the concerned discipline/ CGPA of 3.5 in the UGC Seven Point scale

2. Scheme of Examination
Science

S. NO.	Paper	ESE	CIA	TOTAL
1.	Theory	70%	30%	100
2.	Practical	60 %	40 %	100

Each theory paper syllabus is divided into four units. Each theory paper 3 hours duration.
Each Practical /Lab work 6 hours duration
The number of papers and the maximum marks for each paper/ practical shall be shown in the syllabus for the paper concerned. It will be necessary for a candidate to pass in the theory part as well as the practical part of a subject separately.
Note: Maximum marks for a theory paper is 100 marks which includes 70 marks for ESE and 30 marks for internal assessment.

Examination Question Paper Pattern for all semester Exams
M.Sc.
Part I
I -08 Questions (very short answer questions. Any 7 from 8 questions) 7 * 2 Mark - 14
Part-II
4 Questions (1 question from each unit with internal choice) 4 * 14 Marks - 56
Total of End Sem. Exam - 70
Internal Assessment - 30
Maximum Marks - 100
Minimum Marks – 40

3. Semester Structure

The details of the course with code, title and the credits assign are as given below.

Abbreviations Used
Course Category
DSC: Discipline Specific Core
DSCP: Discipline Specific Core Practical
DSE: Discipline Specific Elective
DSEP: Discipline-Specific Elective Practical
GE: General Elective
AEC: Ability Enhancement Course
AECC: Ability Enhancement Compulsory Course
SEC: Skill Enhancement Course
SEM: Seminar
PRJ: Project Work
RP: Research Publication

Contact Hours
L: Lecture
T: Tutorial
P: Practical or Other
S: Self Study
The medium of instruction and examination shall be Hindi/English.

M.Sc. (Botany)

S. No.	Subject code	Paper	Course category	Credit	Contact hours per week			ESE Duration (Hrs.)	
					L	T	P	Theory	P
1.	MBOT	Theory	DSC	4	4			3	
2.	MBOT	Theory	DSC	4	4			3	
3.	MBOT	Theory	DSC	4	4				
4.	MBOT	Theory	DSC/ DSE	4	4				
5.		Practical – I	DSCP	6			6		6
6.		Practical - II	DSCP/ DSEP	6			6		6

This pattern follows in all the semesters. In third and fourth semester student may select one elective paper (DSE) from group of the three subjects as fourth paper.

Course structure - Nomenclature of Papers

Semesters	Code	Name of paper	Credits	Total Credits
Semester - I	DSC MBOT 101	Cell Biology and Evolution	4	28
	DSC MBOT102	Morphology and Diversity of non-vascular plants	4	
	DSC MBOT103	Biology and Diversity of Microbes	4	
	DSC MBOT104	Plant Ecology and Environment	4	
	DSCP MBOT P-I	Practical I based on MBOT 101& 102	6	
	DSCP MBOT P-II	Practical I based on MBOT 103 & 104	6	
Semester - II	DSC MBOT 201	Genetics and Plant Breeding	4	

	DSC MBOT 202	Morphology and diversity of vascular plants	4	28
	MBOT 203	Phytopathology	4	
	MBOT 204	Plant Physiology and metabolism	4	
	DSCP MBOT P-I	Practical I based on MBOT 201&202	6	
	DSCP MBOT P-II	Practical II based on MBOT 203 204	6	
Semester - III	MBOT 301	Molecular Biology	4	28
	MBOT 302	Taxonomy of Angiosperm	4	
	MBOT 303	Morphology and developmental anatomy of angiosperm	4	
	DSE MBOT 304 A/B/C	A. Adv. Plant Patho. B. Seed Sci. and Tech. I C. Adv. Plant Physio.	4	
	DSCP MBOT P-I	Practical I based On MBOT 301 & 30 (Seminar presentation in Internal Practical)	6	
	DSEP MBOT P-II	Practical II based on MBOT 303 & 304 (A/B/C) Synopsis submission and viva-voce in Internal Practical	6	
Semester - IV	MBOT 401	Embryology of Angiosperm	4	
	MBOT 402	Plant Resource Utilization and Ethnobotany	4	

	MBOT 403	Plant Biotech. and Genetic Engineering	4	28
	MBOT 404 A/B/C	A. Adv. Plant Patho.- B. Seed Sci. and Tech II C. Plant Physiology I	4	
	DSCP MBOT P-I	Practical I based on MBOT 401 &402	6	
		Practical II based on MBOT 403 & 404 (A/B/C) Dissertation submission in Interna Practical	6	
		Total Credits	**112**	**112**

S. S. Jain Subodh P.G. College, Jaipur (Autonomous)
CBCS Scheme for M.Sc. (Botany)

SEM.	CORE COURSE	ELECTIVE COURSE	Credits
	DSC (56)	**DSC & DSE (56)**	
1	DSC-1 (4) DSC-2 (4) DSC-3 (4) DSC-4 (4) Practical-1 (6) Practical-2 (6)		**28**
2	DSC-1 () DSC-2 (4) DSC-3 (4) DSC-4 (4) Practical-1 (6) Practical-2 (6)		**28**
3		DSC-1 (4) DSC-2 (4) DSC-3 (4) choose any one from group A. DSE-A 1 (4) DSE-A 2 (4) DSE-A 3 (4) Practical - I (6) Internal assessment is based on seminar. Practical - II (6) Internal assessment is based on the synopsis of the dissertation and viva.	**28**
4		DSC-1 (4) DSC-2 (4) DSC-3 (4) choose any one from group B. DSE-B 1 (4) DSE-B 2 (4) DSE-B 3 (4) Practical - I (6) Internal assessment is based on seminar. Practical - II (6) Internal assessment is based on dissertation	**28**
		TOTAL CREDITS	**112**

In the third Semester and fourth Semester, departments will offer three theory elective courses. Students can choose any one elective as fourth paper.

Programme specific Outcomes- for Postgraduate Programme M.Sc. Botany

Upon successful completion of M.Sc. Botany Post-Graduates are expected to-

PSO1: Develop a conceptual understanding of principles and importance of Botany. Students would be benefited with knowledge of core subjects like plant diversity, physiology and biochemistry, molecular cytogenetic and application of statistics etc. which are offered in these subjects Modules on analytical techniques, plant tissue culture and photochemistry would make them obtain skills that help in doing research.

PSO2: Learn about practical technique in lab for detail study of plant cell structure, reproduction, anatomy, breeding procedures for hybridization. Maintain a high level of scientific excellence in botanical research with specific emphasis on the role of plants. Create, select and apply appropriate techniques, resources and modern technology in multidisciplinary way. Practice of subject with knowledge to design experiments, analyze and interpret data to reach to an effective conclusion.

PSO3: They would identify, formulate and analyze the complex problems with reaching a substantiated conclusion. Logical thinking with application of biological, physical and chemical sciences. Learning that develops analytical and integrative problem-solving approaches.

PSO4: Students would perform functions that demand higher competence in national/international organizations with sporty and helping spirits. Prepare the students for many competitive exams like MPSC, UPSC NET SET GATE.

PSO5: Best problem-solving skills in students would encourage them to carry out innovative research projects thereby making them to use knowledge creation in depth. Enable the students to be resourceful in identifying the plants

PSO6: Knowledgeable, disciplined students with good values, ethics, and kind heart will help in nation building globally. Student should be aware of ethical issues and regulatory considerations while addressing society needs for growth with honesty

S. S. Jain Subodh P.G. (Autonomous) College Jaipur
Department of Botany
MASTER OF SCIENCE

SEMESTER- I

S.no.	Subject Code	Course Title	Course Category	Credits	EoSE Duration (hrs)		EoSE Assessment			
					Theory	Practical	External	Internal	Min. marks	Max. marks.
1.	101	Cell Biology and Evolution	DSC	4	3	0	70	30	40	100
2.	102	Morphology and diversity of non-vascular plants	DSC	4	3	0	70	30	40	100
3.	103	Biology and Diversity of Microbes	DSC	4	3	0	70	30	40	100
4.	104	Plant Ecology and Environment	DSC	4	3	0	70	30	40	100
5.	151	Practical I based on MBOT 101&102	DSCP	6	0	4	60	40	40	100
6.	152	Practical II based on MBOT 103&104	DSCP	6	0	4	60	40	40	100

Course Out comes-

MBOT 101-Cell Biology and Evolution-

Course provide knowledge of structural organization and function of Organelles, Cell division and cell cycle, Cell signaling hormones and their receptors, Cellular communication, Mechanism of apoptosis (Programmed Cell Death), Paleontology and Evolution, History and concepts of Population Genetics.

MBOT102- Morphology and diversity of Non- vascular plants -

Students will gain understanding of morphology of thallus structure, reproduction and economic importance of algae.
Students will gain understanding of the classification, cell structure, reproduction of fungal species and evolutionary tendencies among them. They will know economic importance of fungi.
Student will also know and learn classification and phylogenetic relationship in fungi.
The characters, distribution, classification and reproduction in Bryophytes. The characteristics of different orders in reference to different genera Bryophytes.

MBOT 103 - Biology and Diversity of Microbes-

Students will be able to understand the structure, type and identification of Bacteria, Virus, Mycoplasma and cyan bacteria and microbial technology**,** food microbiology, environmental microbiology and Immunology

MBOT 104- Plant Ecology and Environment

Students will be able to understand the structure and function of ecosystem, Homeostasis and cybernetics. Population characteristics, dynamics, species interaction, Characteristics of community, succession and mechanism of succession. Biodiversity conservation, its policies, act and conservation strategies.

M.Sc. SEMESTER I

MBOT-101
Cell Biology and Evolution Credit-4

Unit-I

Structural organization and function of Organelles: Cell wall, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic reticulum, Peroxisomes, Plastids, Vacuoles, structure and function of Cytoskeleton and its role in motility.

Membrane Structure and Function: Structure of plasma membrane models, lipid bilayer and membrane protein (Diffusion, Osmosis, Ion channels, active transport and membrane pumps).

Intracellular compartments and transport: Mechanism of protein sorting in peroxisomes, nucleus, chloroplast, mitochondria, ER and regulation of intracellular transport. (15hrs)

Unit -II

Cell division and cell cycle: Mitosis and Meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.

Cell signaling hormones and their receptors: Cell surface receptors, second messengers, signaling through G-protein coupled receptors, signal transduction pathway (cyclic AMP, phospholipase C, Ca^{+2} calmodulin & receptor tyrosine kinase pathway).

Cellular communication: General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins. (15hrs)

Unit -III

Apoptosis (Programmed Cell Death): Mechanism of apoptosis, apoptosis triggered by internaland external signals, apoptosis inducing factors, cancer, oncogenesis.

Emergence of evolutionary thoughts: Lamarck, Darwin- concepts of variation, adaptation, struggle, fitness and natural selection, Mendelism, spontaneity of mutations.

Origin of cells and unicellular evolution: Origin of basic biological molecules, abiotic synthesis of organic monomers and polymers, concept of Oparin and Haldane, Experiment of Miller (1953), The first cell, Evolution of prokaryotes, Origin of eukaryotic cells, Evolution of unicellular eukaryotes. (15hrs)

Unit -IV

Paleontology and Evolutionary History: The evolutionary time scale, Eras, Periods and Epochs.

Major events in the evolutionary time scale, Origins of unicellular and multicellular 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, Allopatric and Sympatric, Convergent evolution, Sexual selection, Co-evolution. (15hrs)

Suggested Laboratory Exercises:

1. EM study of cell organelles
2. Fluorescence staining with FDA for cell viability
3. Cell wall staining with calcofluorwhite
4. Study of stages in cell cycle
5. Mitosis and Meiosis
6. Histochemical localization of protein, carbohydrate, fats, starch, lignin, nucleic acids

7. Demonstration of SEM and TEM
8. Isolation of chloroplast and study of its percentage intactness
9. Isolation of chloroplast and study of light reaction system.
10. Isolation of Mitochondria and the activity ofits marker enzyme, succinate dehydrogenase (SDH).
11. Hardy- Weinberg numerical.
12. Any other practical based on theory syllabus.

Suggested readings:

1. Krishnamurthy, K.V.2000. Methods in cell wall Cytochemistry. CRCPress, BocaRaton, Florida.
2. Reeve, ECR. 2001. Encyclopedia of Genetics, F.D. Publication, Chicago, USA,
3. DeD.N.2000.Plant Cell Vacuoles: A Introduction. CSIRO Publication, Colling wood, 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. and Hausman, R.E.2009.The Cell: A molecular approach. (V Edition).ASM press and Sunderland, Washington D.C. Sinauer Associates, MA.
6. Becker, W.M., Kleinsmith, L.J., Hardin, J.and Bertoni, G.P. 2009. Theworldofthecell. VII Edition. Pearson Benjamin Cummings Publishing. San Franciso.
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. Harris, N. and Oparka, K.J. 1994. Plant Cell Biology: A Practical Approach. IRL Press, at Oxford University Press, Oxford, U.K.
9. Gunning, B.E.S. and Steer, M.W. 1996. Plant Cell Biology: Structure and Function. Jones and Bartlett Publishers, Boston, Massachusetts.
10. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments.VI Edition. John Wiley&Sons. Inc.
11. Griffiths,A.J.F.*etal*.2000.An introduction to geneic analysis.W.H.FreemanandCompany, NewYork,SA.
12. Rana,S.V.S.2012.Biotechniques,theoryand practices(Thirdedition),RastogiPublications,Meerut
13. Roy,S.C.and De,K.K.1999.CellBiology.NewCentralBookAgency(P)Ltd.Calcutta.
14. Hartl, D. L. 1994. Genetics. Jones and Bartlett Publishers International,USA

MBOT 102
Morphology and Diversity of Non-Vascular Plants

Unit –I

Credits-4

Algae: General characterstics, habitats, thallus organization, cell ultrastructure, reproduction (vegetative, asexual, sexual), life cycle patterns, classification of algae, Salient features of Cyanophyta, Chlorophyta, Bacillariophyta, Xanthophyta, Phaeophyta and Rhodophyta, with special reference to *Spirulina, Dunaliella, Pinnularia, Laminaria, Gelidium and Batrachospermum.* Economic importance of algae especially in industries, food, fodder, biofertilizers, biofuels. (15hrs)

Unit -II

Fungi: General characters, life cycle patterns, ultra-structure, mycelial growth, cell wall composition, nutrition (necrotrophs, biotrophs and symbionts), methods of reproduction (Asexual, Sexual). Heterothallism, heterokaryosis, brachymeiosis, parasexuality. Recent trends in classification and phylogenetic relationship among fungal groups. (15hrs)

Unit -III

General account of *Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, & Deuteromycotina* with special reference to *Peronospora, Rhizopus, Neurospora, Polyporus, Drechslera & Colletotrichum.* Economic importance of fungi in industries, medicines and as food, fungi as biocontrol agents, poisonous fungi, mycorrhizae. (15hrs)

Unit -IV

Bryophyta: Distribution, morphology, structure, reproduction & classification of Bryophytes. General account of *Marchantiales, Jungermanniales, Anthocerotales, Sphagnales, Funariales, & Polytrichales* with special reference to *Plagiochasma, Notothylus* and *Polytrichum.* Fossil Bryophytes. Origin and evolution of bryophytes, Economic importance of bryophytes, role of bryophytes in succession. (15hrs)

Suggested laboratory exercises:

Morphological study of representative members of algae, Fungi and Bryophytes present in your locality in their natural habitat with special references to:

Alage: *Microcystis, Spirulina, Rivularia, Dunaliella, Aulosira, Pediastrum, Hydrodictyon, Ulva, Pithophora, Stigeoclonium, Gelidium* and *Batrachospermum*; isolation and culture ofalgae.

Fungi: *Stimonitis, Peronospora, Pythium, Albugo, Pilobolus, Yeast, Emericella, Chaetomium, Pleospora, Morchella, Melampspora, Phallus, Polyporus, Dreschlera, Curvularia, Phoma, Penicillium, Aspergillus, Colletotricum, Fusarium and Alternaria;*

Isolation and culture of fungi using moistened blotters, PDA and sabouraud's dextrose agar media.

Bryophyte: *Plagiochasma, Pellia, Physcometrella patens, Notothyllus* and *Polytrichum.*

Suggested Reading:

1. Alexopoulus, CJ. mims, C. W and Blackwel, 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. Vols. Cambridge university Press.Cambridge.UK.
4. Fritsch. F.E. (1945). The structure and Reproduction of Algae. Vol ll. University press, Cambridge.UK.

5. Caves, F. Inter -relationship of the Bryophyta, New Phytologist, ReprintNo.4.1911, Indian Reprint. S.R. Technician, Book House, Patna,1981, pp212.
6. Kashyap, S.R. (1932) Liverworts of Western Himalayas and Punjab Plains (Vll. I&II) Research co Publication, New Delhi, pp 137, pp. 129.
7. Richardson, D.H.S. Biology of Mossses (1981). Blackwell Scientific- Publication Oxford, pp.220.
8. Bold, H.C., Alexopoulus, C.J. and- Delevoryas. T. (1980): Morphology of plant and Fungi (4th Ed.) Harper& Foul CO., New York.
9. Ghemawat, M.S. Kapoor JN., and Narayan, H.S(1976): Latest book of Algae. Ramesh bookDepot.Jaipur.14.
10. Gilbert. M. Smith Cryptogamic Botany, vol I&II (2nd EDITION) 1985. Tata Mcgraw hill pub.Co. New Delhi.
11. Puri. P. Bryophytes (1985) Atmaram & sons, Delhi. Lucknow
12. Sharma. P. D. (1996) Introduction to Bryophytes, Ramesh Book depot, Jaipur

MBOT 103

Biology and Diversity of Microbes

Unit -I **Credit-4**

Introduction and classification

History, scope and developments since 20_{th} century. Bergey's manual of systematic bacteriology. Nutritional classification of microorganisms, Modern trends in classification (ribotyping, nucleic acid hybridization, RNA fingerprinting, molecular chronometer).

Microbial diversity: Occurrence, salient features of following: Proteobacteria, non –proteobacteria (Gram negative bacteria), Gram positive bacteria. Spirochaetes, rickettsias, mycobacteria, actinomycetes, chlamydomonas, Cyanobacteria.

Mycoplasma- General characteristics, ultrastructure and reproduction. (18 hrs.)

Unit -II

Morphology, ultra-structure and cultivation of bacteria: Morphology and ultra-structure of bacteria, cytoplasmic inclusions, plasmids and endospores, anaerobic and aerobic culture media, growth curve, batch, continuous culture, pure culture techniques.

Archaebacteria- methanogens, extremophiles, halophiles and thermophiles.

Viruses: Classification and nomenclature with cryptograms, properties and structure of viruses, life cycle and pathogenesis of following: RNA viruses-retero, Corona, rhabdo; DNA viruses – herpes;

Plant viruses-cauliflower mosaic and turnip yellow mosaic. (18 Hrs.)

Unit -III

Immunology: General account of immunity, properties of antigens and antibodies, antibody structure and function, affinity and antibody specificity, serology, antigen-antibody interaction, MHC molecule, antigen processing, activation and differentiation of B and C cell receptors, humoral and cell-mediated immune responses. Monoclonal antibodies and their uses,

Vaccination and vaccines, Interferons. (12 Hrs.)

Unit -IV

Microbial Technology: Microbial Fermentation, Fermentation media, Upstream and Downstrean processing and Industrial production of alcohol, organic acids, amino acids, enzymes, antibiotics.

Agriculture Microbiology and waste management: Biopesticides and biofertilizers, Biofuels, Biogas, vermicomposting, sewage treatment (cesspools, septic tanks, oxidation pond, trickling filters, Activated sludge)

Food Microbiology: Microbial spoilage of food products, and their control. Fermented foods-wine, Bakery products and their nutritional value.

Environmental microbiology: Biodegradation and bioremediation. Brief account of biofilms and biochips. (12hrs.)

Suggested Laboratory Exercises

1. Preparation of culture media-liquid and solid media, enrichment, selective, preparation of slant, deep tube and plate culture.
2. Isolation of pure culture by pour plate, serial dilution and streak plate method.
3. Study of growth curve.
4. Effect of pH, temp, osmolarity and Oxygen, UV, dessication on growth of bacteria.
5. Sterilization methods.
6. Methods of quantitative estimation of microorganisms.
7. Total counts (haemocytometer method), viable counts (plate count), WBC and RBC counts.
8. Methods of staining bacteria (simple staining, Gram's staining, negative staining).

9. Endospore staining.
10. Fermentative production of ethyl alcohol by Yeast.
11. Extraction and detection of aflatoxin in infested foods.
12. Blood grouping and Rh factor.
13. Haemoglobin estimation.
14. To study spontaneous mutations by replica plating.
15. To study induced mutations in bacteria.
16. Antibiotic bioassay (gradient plate technique and disc method).
17. Testing of milk by MBRT, turbidity test for milk.
18. Qualitative estimation of Phosphorus and Calcium in milk.
19. Determination of the most probable number (MPN).
20. Coliform test for milk/water.
21. Isolation of microorganisms from air, water, soil and rhizosphere microflora.

Suggested readings:

1. Frazier, W.C. and Westhoff, D.C. (1998). Food Microbiology. Tata McGraw Hill Publishing Company Ltd. New Delhi.
2. Reed, G. 2004(5_{th}Ed.) Industrial Microbiology. CBS Publishers, AVI Publishing Company, New Delhi.
3. Edward, D. Schroeder, Juana, B. Eweis, 1998. Bioremediation principles. Tata Mc Graw Hill, Publishing Company Ltd., NewDelhi.
4. Stainer,R.Y., Ingraham, JohnL. and Mark L. Wheelispagex. 1992. General Microbiology. McMillian Press, UK.
5. Atlas, Ronald, M.1997.Principle of Microbiology. Tata Mc Graw Hill, Publishing Company Ltd. New Delhi.
6. Peleczar, Michael, J., Chan, E.L.S. and Krieg, N.R. 1996. Microbiology, Tata Mc Graw Hill, Publishing Company Ltd., New Delhi.
7. Michael, T. Madigan, Martinko, Joh. M. and Parker, Jack 2010 (13_{th} Ed.) Brock's Biology of Microorganisms. Prentice Hall, US.
8. BlackJ.G.1995.Microbiology principles and applications. John Wiley, Prentice Hall, US.
9. Michael, R. 1999. Introduction of Environmental Microbiology. ASM books, Washington Dc.
10. Graham, Sir, Wilson, S. and Miles, Sir Ashley, Vol. I. Principles of Bacteriology, Virology and Immunity. 1975 (6_{th} Ed.). Edward Arnold Publisher Ltd.,London.
11. Collins, C.H. and Patrica, M.Lyne 1976. Microbiological methods. Butter worth and Co. Publisher Ltd., Boston,US.
12. Maier, Raina M., papper, Lan L., Gerba, Carles P. 2009 (IInd edition) Environmental Microbiology. Academic Press, Elsevier, London,U.K.
13. Manual of Microbiology: Tools and Techniques ;Kanika Sharma.Anebooks.NewDelhi.2007.
14. Textbook of Microbiology; Kanika Sharma. Ane books. New Delhi.2011.

MBOT 104
Plant Ecology and Environment

UNIT-I **Credit-4**

Introduction to Ecology

Population: Characteristics of population, population size and exponential growth, limits of population growth, population dynamics, life history patterns, fertility rate and age structure, population growth.
Species interactions: types of interactions; Competition and coexistence, intra-specific interactions, interspecific interactions, scramble and contest competition model, mutualism, commensalism and allelopathy, prey-predator interactions. (15hrs)

UNIT-II

Vegetation organization: Concepts of community and continuum, community coefficients, interspecific associations, ordination, species diversity and pattern diversity in community, Diversity indices, concept of habitat and ecotone, ecological niche.
Vegetation development: Temporal changes (cyclic and non-cyclic), mechanism of ecological succession (relay floristic and initial floristic composition), succession models (facilitation, tolerance and inhibition models), Changes in ecosystem properties during succession, concept of climax. (15hrs)

UNIT-III

Ecosystems: Ecosystem structure and function. Grassland and Detritus food chain in freshwater ecosystems, food webs, Ecological energetic: Solar radiation and energy intake at the earth's surface, Energy flow models, Productivity of various ecosystems of the world and global biogeochemical cycles of carbon, nitrogen and phosphorus, Ecosystem Management: Homeostasis and cybernetics of ecosystem, Resilience of ecosystem, Restoration of degraded ecosystems, Ecology of plant invasion. Ecosystem services. (15hrs)

UNIT-IV

Biomes, Biodiversity and Conservation: Major biomes of the world and Impact of changing climate on biomes, Biodiversity assessment (local, national and global), loss of diversity. International Conservational organizations, biodiversity act of India and related international conventions. Sustainable development and natural resource management in changing environment. Molecular ecology, genetic analysis of single and multiple population, molecular approach to behavioral ecology. (15hrs)

Suggested Laboratory Exercises

1. To determine minimum size and number of quadrate required for reliable estimate of biomass in grassland.
2. To compare protected and unprotected grassland stands using community coefficients (similarity indices).
3. To estimate IVI of the species in a grassland/woodland using quadrate method.
4. To determine grass and net phytoplankton productivity by light and dark bottle method.
5. To determine soil moisture content, porosity and bulk density of soils collected from varying depths at different locations.
6. To determine the Water holding capacity of soils collected from different locations.
7. To determine percent organic carbon and organic matter in the soils of cropland, grassland and forest.
8. To estimate and dissolved oxygen content in eutrophic and oligotrophic water samples by azide modification of Wrinkler's method.
9. To estimate chlorophyll content in SO2 fumigated and unfumigated plants, leaves.
10. To estimate rate of carbon di oxide evolution from different oil using soda lime or alkali absorption method.

11. To study environmental impact of a given development activity using checklist as an EIA method.

Suggested Readings

1. Smith, R.L. 1996. Ecology and Field Biology, Harper Collins, New York.
2. Muller-Dombois,D.and Ellenberg,H.1974.Aims and Methods of Vegetation Ecology, Wiley, New York.
3. Begon, M. Harper, J.L. and Towsend, C.R.1996. Ecology, Blackwell Science, Cambridge, U.S.A.
4. Ludwig,J.and Reynolds,J.F. 1988.Statistical Ecology.JohnWiley andSons.
5. Odum, E.P. 1971. Fundamentals of Ecology, Saunders, Philadelphia.
6. Odum, E.P. 1983. Basic Ecology, Saunders,Philadelphia.
7. Barbour, M.G., Burk, J.H. and Pitts, W.D. 1987. Terrestrial Plant Ecology, Benjamin/Cummings Publications Company,California.
8. Kormondy,E.J.1996.Concepts of ecology.Prentice-HallofIndiaPvt.Ltd.,NewDelhi.
9. Chapman, J.L. and Reiss, M.J. 1988. Ecology, Principles and Applications, Cambridge University Press, Cambridge,U.K.
10. Molan,B.and Billharz, S.1997.Sustainability Indicators, John WileySons, NewYork.
11. Heywood,V.H.and Watson,R.T.1985.Global Biodiversity Assessment.Cambridge University Press.
12. N.S.SubrahmanyamandA.V.S.S.Sambamurty.2000.Ecology.Narosa Publishing House,Jaipur.
13. S.K.Maiti.2004.Hand book of Methods in Environmental StudiesVol.1&2ABDPublisher,Jaipur.
14. J.L.Chapman and M.J.Reiss.1995.Ecology principles andapplications.CambridgeUniversityPress.
15. C.Faurie,C.Ferra,P.MedoriandJ.Devaux.2001.Ecology Science and Practice.Oxfordand IBH Publishing Co. Pvt. Ltd. NewDelhi.
16. G.T. Miller Jr. 2005. Essentials of Ecology. III Edition, Thomson, Brooks/Cole.

M.Sc. SEMESTER II

SEMESTER II

S. No.	Subject Code	Course Title	Course Category	Credits	EoSE Duration (hrs)		EoSE assessment			
					Theory	Practical	External	Internal	Min. marks	Max. marks.
1.	201	Genetics and Plant breeding	DSC	4	3	0	70	30	40	100
2.	202	Morphology and diversity of vascular plants	DSC	4	3	0	70	30	40	100
3.	203	Phytopathology	DSC	4	3	0	70	30	40	100
4.	204	Plant Physiology and Metabolism	DSC	4	3	0	70	30	40	100
5.	251	Practical I based on MBOT 201&202	DSCP	6	0	4	60	40	40	100
6.	252	Practical II based on MBOT 203&204	DSCP	6	0	4	60	40	40	100

Course outcomes

MBOT 201- Genetics and Plant breeding-

Understanding of the history of gene,"factor"; and gene and one gene one enzyme one characters hypothesis. Student will also know the interaction of gene, genetic recombination.

Understanding of the structure of chromosome and how the packaging of DNA occurs.

Student can differentiate Euchromatin and heterochromatin region of chromosome on the basis of staining properties. Student can draw a good karyotype and Idiograms of Karyotype, and also how the evolution of Karyotype takes place.

Understanding of the different structural and numerical changes why? And how?

Understanding the role and process of mutation and different mutagenic agent which brings about mutation in the organism and molecular cytogenetics. Students will also understand the role of mutation in crop improvement with plant breeding methods.

MBOT 202 -Morphology and diversity of vascular plants-

Students understand morphology, anatomy and life cycle of Pteridophytes and Gymnosperm with special reference to Genera different classes.

Students understand various extinct members of different orders. Students can critically differentiate fossil and living fossil.

Students will also understand the evolutionary tendencies and comparative morphology of Cycadales,

Cycadeodales and Pteridospermales.

Students can compare the characters of different orders &relationship of each order from Cordaitales to Gnetales. Student can critically differentiate the characters of three orders of Gymnosperm i.e., Ginkogales, Coniferales, and Taxales.

MBOT 203- Phytopathology -

Couse provide knowledge about mechanism of infection and defence mechanism, symptomology, toxins and enzyme secreted by plants.

Students gain knowledge about some disease caused by different Pathogens.

MBOT 204 -Plant Physiology and metabolism

Understanding of water relations, transport of minerals, their role, transport of ion, transpiration and closing and opening of stomata.

Course gain knowledge of Biochemistry of primary and secondary metabolites viz. carbohydrate, fat, protein.

Detail mechanism of Respiration and photosynthesis

Physiology of growth, growth hormones their role, physiology of flowering, vernalisation and senescence.

M.Sc. SEMESTER II

MBOT 201
Genetics and Plant breeding

Credit-4

Unit-I

Gene Structure and expression: Genetic fine structure, Cis-trans test, fine structure analysis of gene in eukaryotes.

Inheritance and allelism: Mendalian and non-Mendalian inheritance, Extra nuclear inheritance: cytoplasmic male sterility, inheritance of mitochondrial and chromosomal plant genes. sex determination, sex-linked inheritance, sex-limited characters and sex reversal, multiple alleles and blood group in man, genome imprinting. penetrance and expressivity, phenocopy.

Genetic recombination: Homologous and non-homologous recombination, Independent assortment and crossing over, molecular mechanism of recombination, Holiday junctions, site-specific recombination, FLP/FRT and Cre/lox recombination, role of Rec A and Rec BCD enzymes and other recombination.

(15 hrs)

Unit-II

Mutation and Types of DNA damage: Mutagens and their effects–Physical (Radiations) and Chemical base analogues, intercalating agents, alkylating agents and others. Types of mutation – Spontaneous and induced mutations, lethal, conditional, biochemical, loss and gain of function. Base substitutions, frameshift mutation, germinal verses somatic mutation, mutations induced by transposons.

Repair mechanisms of mutational DNA damages: Direct reversal of damages, photoreactivation and dealkylation, excision repair mechanism, (NER, BER), post replication repair mechanisms (Mismatch repair and Recombination repair), SOS repair, inherited diseases and defects in DNA repair

Mutagenesis: Insertional mutagenesis, site-directed mutagenesis, in vitro mutagenesis and deletion techniques, Ames test for mutagenesis, ploidy and their genetic implications.

(15hrs)

Unit-III

Chromosome mapping: Linkage map, mapping with genetic markers including RAPD, QTL, construction of molecular maps, restriction mapping–concept and technique, correlation of genetic and physical maps, mapping by using somatic cell hybrids.

Structural and numerical alterations in chromosomes: Origin, meiosis and breeding behaviour of duplication, deficiency, inversion and translocation heterozygotes. Origin, occurrence, production meiosis of haploids, aneuoploids and euploids, origin and production of autopolyploids, chromosome and chromatid segregation, allopolyploids types; genome constitution and analysis, evolution of major crop plants, induction and characterization of trisomics and monosomics.

(15hrs)

Unit-IV

Molecular cytogenetics: Nuclear DNA content, C-value paradox, cot curve and its significance, multigene families and their evolution, in situ hybridization–concept and techniques (FISH, GISH), computer assisted chromosome analysis. An idea about Proteomics, Genomics and Epigenomics.

Plant breeding

Genetic system and breeding methods: Breeding for crop quality (protein and oil), biotic (diseases and insect-pests) and abiotic (heat, frost, flood, drought) stresses, gene pyramiding for multi trait incorporation. Genetic control and manipulation of breeding systems including male sterility and apomixis. (15 hrs)

SUGGESTED LABORATORY EXERCISES:

1. Study of Hardy-Weinberg Law using simulations.
2. Linear differentiation of chromosomes through banding techniques, such as G-banding, C-banding and Q- banding.
3. Silver banding for staining nucleolus-organizing region, where 18S and 28 S rRNA are transcribed.Working out the effect of mono and trisomy on plant phenotype.
4. Induction of polyploidy using colchicine
5. Different applications of colchicine.
6. Study of variations in plants due to numerical alterations in chromosomes.
7. Numericals based on inheritance and gene interactions.
8. Flow cytometry and confocal microscopy.
9. Emasculation, crossing and Bagging in crop plants.
10. Any other practical based on theory syllabus.

Suggested Readings:

1. Atherly, A.G., Girton, J. R. and McDonald,J.F. 1999. The Science of Genetics. Saunders College Publishing. Fort Worth.USA.
2. Gardner,E.J.,Simmons,M.J.,Snustad,O.P.PrinciplesofGenetics,John Wileyand SonsInc.
3. M.R.Neuman.IntroductiontoMolecularBiology,GenomicsandProteomicsforBiomedicalEngineers.CR C Press,
4. Lewin, B. Genes IX. Jones and BartlettPublishers.
5. Burnham,C.R.1962.DiscussionsinCytogenetics.Burgess PublishingCo.Minnesota
6. Busch,H.andRothblum,L.1982.VolumeX.TheCellNucleusrDNAPartA. AcademicPress.
7. Hartl, D.L. and Jones, E. W. 1998. Genetics: Principles and analysis (4_{th} edition). Jones andBartlett Publishers, Massachusetts,USA.
8. Khush,G.S.1973.CytogeneticsofAneuploids.AcademicPress,NewYork,London.
9. Russel, P.J. 1998. Genetics (5^{th} edition). The Benjamin/ Cummings Publishing Company INd. USA.
10. Fukui, K.andNakayama,S.1996.PlantChromosomes:LaboratoryMethods.CRCPress,BocaRatan, Florida.
11. Sharma, A. K. and Sharma, A. 1999. Plant Chromosome Analysis, Manipulation and Engineering. Hoarwood Academic Publisher, Australia.
12. Acquaah, G. 2007. Principles of Plant Genetics and Breeding. Blackwell Publishing Ltd. USA.
13. Allard, R. W. 1999. Principles of Plant Breeding(2^{nd} edition), John Willey and Sons.
14. Snustad, D.P. and Simmons, M.J.2009.Principles of Genetics (V Edition). John Willey and Sons Inc. USA.
15. Klug, W.S., Cummings, M. R., Spencer, C.A. 2009. Concepts of Genetics (XI Edition). Benjamin Cummings Publishing Company INd. USA.
16. Russell, P. J. 2009. Genetics- AMolecular Approach. (III Edition). Benjamin Cummings Publishing Company INd. USA
17. Pevsner, J. 2009. Bioinformatics and Functional Genomics (II Edition). John Willey & Sons.

MBOT: 202

Morphology and Diversity of Vascular Plant **Credit-4**

Unit-I

Pteridophytes –General characterstics, distribution, classification by ICBN. Economic importance of Pteridophytes. Brief account of fossil Pteridophytes classes: Psilopsida, Lycopsida, sphenopsida and Pteropsida (15hrs)

Unit-II

Morphology, anatomy, reproduction, life history and classification of *Tmesipteris, Isoetes, Gleichenia, Ophioglossum & Azolla;* Origin and evolution of stele, heterospory and seed habit. (15hrs)

Unit-III

Gymnosperms- General account, distribution and classification of gymnosperms. Morphology, anatomy, reproduction, life history and evolutionary trends of– Cyacadales, (*Zamia*), Ginkgoales (*Ginkgo*), Coniferales (*Taxus)*, Welwitchiales (*Welwitschia*), Gnetales (*Gnetum*). Economic importance of gymnosperms.

(15hrs)

Unit-IV

Paleobotany- History, formation and types of fossils, techniques of fossil study, Geological time scale. Brief account of Pteridospermales (*Lygenopteris, Medullosa, Caytonia,* and *Glossopteris*), brief account of cycadeoidales (*Cycadeoidea*),cordaitales (*Cordaites).* Paleobotany and evolutionof vascular plants. Applied aspects of paleobotany, use in coal and petroleum exploration. (15hrs)

Suggested laboratory exercise:

Morphological and anatomical study of representative members of Pteridophytes and Gymnosperm in their natural habitat found in your locality with special reference to *Lycopodium, Isoetes,Gleichenia, Ophioglossum* and *Azolla* in Pteridophytes. *Zamia, Ginkgo, Taxus, Araucaria,Cedrus, Biota* and *Gnetum* in gymnosperms, study of fossils.

Suggested Reading:

1. Parihar,N.S.1996. Biology & Morphology of pteridophytes. Central Book Depot.Allahabad.
2. Sporne,K.K.1991.TheMorphology of Pteridophytes.B.I.PublishingPvt,Ltd.Bombay.
3. Stewart,W.N.and Rathwell.G.W.1993.Paleobotany and the Evolution ofplants.CambridgeUniversityPress,UK.
4. Bhatnager,S.P. and Moitra.A.1996.Gymnosperm. New Age International Pvt. Ltd.NewDelhi.
5. Singh.H 1978 Embrylogy of Gymnosperm. Encyclopedia of Plant anatomy X. Gebruder Bortraeger. Berlin Germany
6. Smith.G.M 1955 Cryptogamic Botany Vol II Tata Mc.Graw Hillbook CompanyNY
7. Pandey, B.P. 1993 College Botany Vol.II S. Chand & companyltd
8. Arnold, Chester A 2000 Introduction to Paleobotany, Agrobios, India
9. Rashid A. 2001. an Introduction to Pteridophyta (II edition) Vikash Publishing house Pvt/ Ltd, New Delhi.
10. S,2001 Introduction to Pteridophyta, New Age International Publishers, New Delhi

MBOT: 203

Phytopathology Credits-4

Unit-I

Plant diseases: Introduction, general account of disease development. History of plant pathology. Nature and concept of Plant Disease. Symptoms of Plant diseases caused by plant pathogen.
Biotic and abiotic factors in pathogenesis, pathogen factors in disease development. Dissemination of plant pathogens and Virus Transmission. (15 hrs)

Unit -II

Pathogenesis: Mechanism of Penetration and entry by Plant Pathogens. Enzymes and Toxins in Plant Disease. Host-specific and Non-host-specific toxins. Protective and defense mechanism in plants – Morphological and biochemical.
Management of Plant disease: Physical, Chemical and Biological. Biopesticides, Plant Disease Clinics. (15 hrs)

Unit-III

Symptomology, identification and control of following Plant Diseases: Fungal diseases: Wheat – Flag smut, Karnal bunt, Tikka disease of Groundnut
Bacterial diseases: Wheat: Tundu disease. Black rot of Crucifer (15hrs)

Unit -IV

Symptomology, Identification and Control of Following Plant Diseases:
Viral diseases: Cadang – Cadang disease of Coconut. Leaf Curl of Tomato
Nematode disease: Root Knot of Brinjal, Ear Cockle of Wheat
Non-Parasitic Diseases: Black Heart of Potato. Mango necrosis (15 hrs.)

Suggested Laboratory Exercises:

- Isolation of antibiotic resistant colonies by antibiotic disc method / gradient plate method.
- Hanging drop method.
- Grams stain for different bacteria
- Negative staining technique of bacteria
- Determination of growth curve ofbacteria
- Identification of fungal cultures
- Isolation of microorganism from soil
- Study of following disease

1. Tikka disease of groundnut
2. Black rot of crucifer
3. Tundu disease of wheat
4. Leaf curl of Tomato
5. Root knot of Brinjal
6. Ear cockle of wheat
7. Mango necrosis

Suggested Readings:

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. Khan, J.A. and J. Dijkstra. 2002. Plant Virus as Molecular Pathogens. The Haworth Press Inc. USA.
4. Mehrotra, R.S. and A. Agarwal. 2003. Plant Pathology. 2nd Edition. TATA McGraw Hill. Pub. Company Ltd. New Delhi.
5. Singh, R.S. 1982. Plant Pathogens : The Fungi. Oxford and IBH Publishing Company, New Delhi, India Singh,
   R.S. 1982. Plant Pathogens : The Fungi. Oxford and IBH Publishing Company, New Delhi, India.
6. Singh, RS. 1989. Plant Pathogens : The Prokaryotes. Oxford and IBH Publ. Company, New Delhi, India.
7. Trigiano, R.N., M.T. Windham and A.S. Windham. 2008. Plant Pathology: Concepts and Laboratory Exercises. 2nd edition. CRC Press.
8. Vidhyasekram, P. 2004. Concise Encyclopedia of Plant Pathology. Food product Press and Haworth Press INc. Binghamton, Ne

MBOT 204

Plant Physiology and Metabolism

Credit-4

Unit-I

Solute transport and photoassimilate translocation: Uptake, transport and translocation of water, ions, solutes and macromolecules from soil through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photo assimilates**.**

Biomolecules: General structure, classification properties, distribution and functions of primary metabolites (carbohydrates, proteins, amino acids, lipids) and secondary metabolites (flavonoids, alkaloids, steroids).

Enzymes –Principles of catalysis, characterstics of enzymes and enzyme kinetics, regulation of enzyme activity, mechanism of action, concept of holozyme, apozyme, ribozyme, abzyme and artificial enzyme.

(15 Hrs.)

Unit-II

Carbohydrate metabolism: Synthesis of carbohydrates-

Photosynthetic pigments, absorption and transformation of radiant energy, (Light harvest complex LHC) photo-oxidation, red drop effect, Emersion enhancement effect, photosynthetic quantum yield, C3, C4 and CAM Pathway, factors affecting photosynthesis, Photorespiration Bacterial photosynthesis.

Degradation of Carbohydrates: Glycolysis, Krebs cycles, Electron Transport System (ETS), Pentose phosphate pathway, Hexose monophosphate shunt, glyoxylate pathway, Glycogenesis, Gluconeogenesis, Respiratory inhibitors, High energy bond compounds, their synthesis and utilization.

(15hrs)

Unit-III

N2 metabolism: N2 fixation symbiotic and asymbiotic, Nodule development, amino acid metabolism.

Fat metabolism: Synthesis of long chain fatty acids, lipid biosynthesis, and oxidation.

Vitamins metabolism: Structure and function (Thiamine, Riboflavin, Ascorbic acid, and Vitamin D)

(15hrs)

Unit-IV

Plant growth regulators (Natural and synthetic): Chemical nature, bioassay, physiological effects and mode of action of Auxins, Gibberelines, Cytokinines, Abscisic acid and Ethylene. Morphactins, Methylhydrazide. Strigolactones, Salicylic acid, Brassinosteroids.

(15 Hrs.)

Suggested Laboratory Exercises:

1. Effect of seed coat on water absorption by dry seeds
2. Effect of the nature of seed on water absorption.
3. Experimentaldemonstrationoflivingnatureofprotoplasmandplasmamembrane.
4. Measurement of leaf area by graph paper / by weighing method.
5. Determination of the rate of transpiration by simple method (conical flask method) and comparison of the rates of transpiration of two different leaves.
6. Determination of stomatal frequency, stomatal area, total number of stomata per leaf and transpiration index.
7. Determination of the effect of antitranspirant chemical on transpiration.
8. Determination of the effect of environmental condition on transpiration rates in plants.
9. Detection of essentiality of mineral elements by sand culture technique.
10. Demonstration of Hill reaction.
11. Effect of Co2 concentration on photosynthesis.
12. Study of the effect of monochromatic light on photosynthesis.
13. Effect of temperature on photosynthesis.

14. Determination of RQ, by Ganong respirometer.
15. Measurement of vertical growth by auxenometer.
16. Auxin bioassay
17. Separation of chlorophyll pigments by paper chromatograph.
18. Separation of chlorophyll pigments bysolvent method.
19. Extraction of water-soluble anthocyanin pigmentsand its characterization.
20. Demonstration of the temp. coefficient (Q10) on physiological process.
21. To prepare standard curve of Sugar.
22. To prepare standard curve of Protein by Lowry method and estimate the protein content in unknown sample.
23. To prepare standard curve of phenol.
24. Estimation of free titrable organic acids from plant materials.
25. Demonstrate the activity of different enzymes- Catalase, Peroxidase, Invertase and Dehydrogenase.
26. Verify Beers and Lambert law.
27. Detection of Alkaloids andTannin.
28. Toseparatetheaminoacidsbypaperchromatographyinthe givenmixture.
29. Qualitative estimation of Carbohydrates, Protein, Fats andOils.

Suggested Readings:

- Hopkins,W.G.and Huner,P.A.2008. Introductionto PlantPhysiology**.** JohnWileyandSons,USA.
- Jain,V.K.2013.Fundamental ofPlantPhysiology.S.Chand andCompanyLtd.,NewDelhi.
- Malik,C.P.andSrivastavaA.K.1982.TextbookofPlantPhysiology.Kalyanipublication,NewDelhi.
- MukherjeeS.,GhoshA.K.2006.PlantPhysiology.NewCentralBookAgency,Calcutta.
- Parashar, A. N. and Bhatia, K. N. 1985. Plant Physiology. Trueman Book Company, NewDelhi.
- Sinha,R.K.2007.ModernPlantPhysiology.2nd EditionTataMcGraw,NewDelhi.
- Taiz,L.andZeiger,E.2006.PlantPhysiology**.**4th Edition,SinauerAssociatesInc.Publishers, Massachusetts,USA.
- Verma, S. K. and Verma, M. 2000. A Text book of Plant Physiology, Biochemistry and Biotechnology. S. Chand and co. Ltd., NewDelhi.
- Verma, V. 2007. Text Book of Plant Physiology. ANE Books,India.
- Berg,J.M.,Tymoczko,J.L.,Stryer,L.2006.Biochemistry.6thEdition,W.H.FreemanandCompany,New York.
- Buchanan, B., Gruissem, W. and Jones, R. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists,USA.
- Conn, E.E., Stumpf, P.K. and Bruening, G. 2006. Outlines of Biochemistry. 4th Edition**,** John Wiley and Sons Inc. New Jersey,USA.
- Elliot,W.H.andElliot,D.C.2009.BiochemistryandMolecularBiology.OxfordPublishers,India.
- Nelson, D.L. and Cox, M.M. 2004. Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman and Company, New York,USA.
- Ranjit,K.2008.Researchmethodology:Astep bystepguideforbeginners.Pearson,India.
- SinhaR.K.,2007.ModernPlantPhysiology.2nd EditionTataMcGraw,NewDelhi.
- Voet, D. and Voet, J.G. 2000. Biochemistry, John Wiley, NewYork.
- Wilson, K. and Walker, J. 2008. Principles and techniques of Biochemistry and Molecular Biology**,** Cambridge UniversityPress.

M.Sc. SEMESTER III

S. No.	Subject Code	Course Title	Course Category	Credits	EoSE duration		E0SE assessment			
					Theory	Practical	External	Internal	Min. marks	Max . marks.
1.	301	Molecular Biology	DSC	4	3	0	70	30	40	100
2.	302	Taxonomy of Angiosperm	DSC	4	3	0	70	30	40	100
3.	303	Morphology and developmental anatomy of angiosperm	DSC	4	3	0	70	30	40	100
4.	304 A/ B/C	A. Adv. Plant Patho. I B. Seed Sci. and Tech. I C. Adv. Plant Physio. I	DSE	4	3	0	70	30	40	100
5.	351	Practical I based on MBOT 301 & 302 (Seminar presentation in Internal Practical)	DSCP	6	0	4	60	40	40	100
6.	352 A/ B/C	Practical II based on MBOT 303 &304 (A/B/C) submission of Synopsis of dissertation/Project work in Internal Practical	DSEP	6	0	4	60	40	40	100

Course outcomes-

MBOT 301-Molecular Biology-

By the end of the course the students will be able to: develop an understanding of key events of molecular biology comprising of
Mechanism of DNA Replication, Transcription and Translation in Prokaryotes and Eukaryotes.
Regulation of gene expression in Prokaryotes and Eukaryotes
Aspects of RNA Interference,
Recombinant DNA Technology

MBOT 302-Taxonomy of Angiosperm-

Course is best in understanding biosystematics methods, concept of species, genera, family, Taxonomic hierarchy. Taxonomic literature, Taxonomic Evidence, ICBN, Latest systems of Classifications and distinguishing characters of families of major classes of Dicot and Monocots.

MBOT 303 Morphology and developmental anatomy of angiosperm

Student understand various theories of SAM and RAM, development of primary and secondary tissues of root, stem, leaf and flower with their genetics and primary & secondary abnormalities

MBOT 304 A. Adv. Plant Patho.I -

Course provide detail knowledge of Plant disease caused by different pathogen with their disease cycles

MBOT 304 B. Seed Sci. and Tech.I

Gross architecture of seed structure of angiosperms, identification and structure of seeds of important crop plants and with special reference to Rajasthan, seed testing, seed germination and seed certification standards and quarantine regulations. International cooperation, International Seed Testing Association (I.S.T.A.)- rules and recommendations.

MBOT 304 C.Adv. Plant Physio. I

Student understand techniques of protein purification, protein sequencing and proteomics, Enzyme kinetics, Nucleotides metabolism, Secondary metabolites: Alkaloid metabolism and vitamins in detail.

M.Sc. SEMESTER III

MBOT: 301
MOLECULAR BIOLOGY

Unit-I

Credit-4

Genes and DNA

Chargaffs rules, Double helical structure of DNA types, DNA supercoiling, Unusual structures of DNA Bends, Palindrome, Mirror repeat, Triplex, Tetraplex, H-DNA), Chemical and physical Properties of DNA, Spectroscopic and Thermal properties, ORF, Exons and Introns.

DNA replication, damage and repair

Initiation, Elongation and Termination. Replicons – linear, circular and D-loops, DNA polymerase, helicase and other enzymes and proteins used in replication, coordinating synthesis of the leading and lagging strands, okazaki fragments, topoisomerase activity, DNA damage and molecular mechanisms of repair-Base excision, Nucleotide excision, recombination repair systems and SOS.

(15 Hrs.)

Unit-II

Transcription, post transcriptional changes

mRNA structure, prokaryotic and eukaryotic RNA Polymerases, Transcriptional factors, promoter sequences, binding sites for RNA Polymerase, transcription initiation. Promoter clearance and elongation, termination. Role of enhancers, repressors, mediators and silencers, transcription inhibitors. RNA splicing and processing- capping, polyadenylation, splicing, spliceosome, mRNA stability, group I introns and transesterification, ribozymes, RNA editing.

(15 Hrs.)

Unit-III

Translation Structure of tRNA, types, Clover leaf model of t-RNA, Ribosome. Genetic code. Translation-formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, aminoacylation of tRNA, aminoacyl tRNA synthatase and termination in prokaryotes and eukaryotes, translational inhibitors. Co and post translational modification of proteins.

Gene regulation

Regulation of gene expression in Prokaryotes- Lac and Trp operons, Positive and negative controls.

Regulation of gene expression in Eukaryotes: Regulation of chromatin structure (Histone modification, DNA methylation. Epigenic inheritance). Regulation of Transcription: Initiation (Role of Transcription factors and enhancers), Post Transcritional regulation, gene silencing (RNA interference, role of mi RNA and siRNA, epigenome and epigenetics.

(15 Hrs.)

UNIT-IV

DNA cloning and Characterization Restriction and other enzymes, Expression vectors, basic steps in gene cloning, genomic and c-DNA libraries, electrophoresis, blotting techniques (Southern, Northern and Western), gene sequencing methods (Sanger's method and Maxam Gilbert's method), nick translation, DNA fingerprinting, PCR, RT-PCR, DNA-microarrays, DNA Protein interaction (DNA footprinting), Protein – protein Interaction (yeast two – hybrid system).

(15 Hrs.)

Suggested Laboratory Exercises:

1. Isolation of nuclei and identification of histones by SDS-PAGE.
2. Isolation of plant DNA and its quantitation by a spectrophotometric method.
3. Isolation of DNA and preparation of cotcurve.
4. Restriction digestion of plant DNA, its separation by agarose gel electrophoresis and visualization by ethidium bromide staining.
5. Isolation of RNA and quantification by a spectrophotometric method.
6. Polymerase Chain Reaction.
7. Southern blot analysis using a gene specific probe.
8. Immunological Techniques: Ouchterlony method. ELISA and westernblotting.

Suggested Readings:

1. Lewis, B. 2001. Genes X. Oxford University Press. New York.
2. Alberts, B. Bray, D., Lewis, J., Raff, M. Roberts, K. and Watson, J. D. 1999. Molecular Biology of the Cell. Garland Publishing, Inc., New York.
3. Wolfe, S. L. 1993. Molecular and Cellular Biology. Wadsworth Publishing Co. California. USA.
4. Rost, T. *et al*. 1998. Plant Biology. Wadsworth Publishing Co. California. USA.
5. Buchanan, B. B., Gruissem, W., and Jones, R. L. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA
6. Lodish, H., Berk, A., Zipursky, S. L., Matsudaira, P., Baltimore, .and Darnell, J. 2000. Molecular Cell Biology (4_{th} Edition). W. H. Freeman and Co. New York, USA.
7. Glick, B. R. and Thompson, J. E. 1993. Methods in Plnt Molecular Biology and Biotechnology. CRC Press. Boca Raton. Horida.
8. Glover, D. M. and Hames, B. D. (Eds.). DNA Cloning 1: A Practical Approach Core Techniques. 2_{nd} Edition PAS IRI Press at Oxford University Press. Oxford.
9. Shaw, C. H. (Ed.) 1988. Plant Molecular Biology: A Practical Approach. IRL Press Oxford.
10. Albert, B., Bray, D., Lewis, J., Raff, M., Robert, K. and Watson, J.D. 1989. Molecular Biology of the Cell (2_{nd} editions). Garland Publishing Inc. New York.
11. Malacinski, G. M. and Freifeider, D. 1998. Essentials of Molecular Biology (3_{rd} edition). Jones and B. Artlet Publishers. Inc. Lomdon.

MBOT 302

Taxonomy of Angiosperms **Credit-4**

Unit-I

Biosystemic studies: Population concept, methods of biosystematics, biosystematics categories – Ecads, Ecotypes, coenospecies, evolution and differentiation of species – various models. ICBN: Principles, rules and recommendations, Taxonomic concept: Hierarchy, species, genus, family and other categories.

(15hrs)

Unit-II

Taxonomic literature: Flora, Monograph, Icones, Library, Manuals, Journals, Periodicals, Index.
Taxonomic tools and techniques: Herbarium preparation, maintenance, utility, important national, international and digital herbaria, serological, molecular technique, GIS and Mapping biodiversity.

(15hrs)

Unit-III

Taxonomic evidences: Morphology, Anatomy, Palynology, Embryology, Cytology, Phytochemistry and Genome analysis.
Classification: Phenetic system; Phylogenetic systems– Cronquist, Dahlgren, Thorne andAPG system with merits and demerits.

(15hrs)

Unit-IV

Salient features of the groups: Polypetalae, Gamopetalae, Monochlamydae and Monocotyledons. Study of the following families- Ranunculaceae, Caryophyllaceae, Sterculaceae, Rhamnaceae, Fabaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Asteraceae, Asclepiadaceae, Apocynaceae, Convulvulaceae, Solanaceae, Acanthaceae, Lamiaceae, Polygonaceae, Chenopodiaceae, Amaranthaceae, Euphorbiaceae, Cyperaceae and Poaceae.

Phylogeny of Angiosperm: Ancestors of angiosperms with special reference to Amborella, time and place of origin of Angiosperms, habit of Angiosperm, primitive living angiosperm, inter relationship among the major groups of Angiosperm. (15hrs)

Suggested Laboratory Exercises:

1. Description of a specimen from representative, locally available families. List of Locally Available Families. (1) Ranunculaceae, (2) Capparidaceae, (3) Portulacaceae, (4) Caryophyllaceae, (5) Malvaceae, (6)Tiliaceae,(7)Sterculiaceae,(8)Zygophyllaceae,(9)Rhamnaceae,(10)Sapindaceae,
   (11) Leguminosae, (12) Combretaceae, (13) Myrtaceae, (14) Cucurbitaceae, (15) Umbelliferae – Apiaceae, (16) Rubiaceae, (17) Asteraceae, (18) Primulaceae, (19) Plumbaginaceae, (20) Asclepiadaceae, (21) Convulvulaceae, (22) Solanaceae, (23) Boraginaceae, (24) Polemoniaceae,
   (25) Acanthaceae, (26) Pedaliaceae, (27) Martyniaceae, (28) Bignoniaceae, (29) Labiatae, (30) Nyctaginaceae, (31) Polygonaceae, (32) Chenopodiaceae, (33) Amaranthaceae, (34) Aizoaceae,
   (35) Molluginaceae, (36) Euphorbiaceae,
   (37) Comelinaceae and (38) Cyperaceae.
2. Description of a species based on various specimens to study intraspecific variation:acollectiveexercise.
3. Description of various species of a genus, location of key characters and preparation of keys at generic level.
4. Location of key characters and use of keys at family level.
5. Field trips within and around the campus, compilation of field notes and preparation of herbarium sheets of such plants, wild or cultivated, as are abundant.
6. Training in using floras and herbaria for identification of specimens described in the class.

7. Demonstration of the utility of secondary metabolities in the taxonomy of some appropriate genera.

   Comparison of different species of a genus and different genera of a family to calculate similarity coefficients and preparation of dendrograms.

Suggested Readings:

1. Cole, A.J. Numerical Taxonomy, Academic Press, London.
2. Davis,P.H.and Heywood,V.H.1973.Principles of Angiosperms Taxonomy ,RobertE.KreigerPub.Co., NewYork.
3. Grant, V. 1971. Plant Specimen, Columbia University Press London.
4. Grant, W.E 1984. Plant Biosystematics, Academic Press, London.
5. Harrison, H.J.1971.New Concept in Flowering Plant Taxonomy.Rieman Educational Book Ltd.U.K.
6. Heslop–Harrison,J.1967. Plant Taxonomy,English Language BookSoc.&Edward ArnoldPub.ltd.U.K.
7. Heywood,V.H.and Moore,D.M.1984.Current Concepts in Plant Taxonomy.Academic Press,London.
8. Jones,A.D.and Wilbins,A.D. 1971.Variations and Adaptations in PlantSpecies.Hiemand&Co.New York.
9. Jones,S.B.Jr. andLuchsinger,A.E.1986.Plant Systematic(2_{nd}Edition).Mc.Graw-HillBookCo.,New York.
10. Nordenstam,B.,ElGazaly,G.andKassas,M.2000.PlantSystematicfor21_{st}CenturyPortlendPressLtd., London.
11. Radford,A.E.1986. Fundamentals of Plant Systematics .Harper & RowPub.,USA.
12. Singh,H.1978. Embryology of Gymnosperms. Encyclopedia of Plant Anatomy X.Gebruder Bortraeger, Berlin.
13. Solbrig,O.T.and Solbrig,D.J.1979.Population Biologyand Evolution, Addison WeslleyPublishingCo. Ind.USA.
14. Solbrig, O.T. 1970. Principles and Methods of Plant Biosystematics. The Macmillan Cocollier-Macmillan Ltd., London.
15. Stace,CA.1989.Plant Taxonomy and Biosystematic (2_{nd}Edition)Edward Arnold Ltd .London.
16. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.
17. Woodland,D.W. 1991. Contemporary Plant Systematic. Prentice Hall, NewJersey.

MBOT: 303

Morphology and Developmental anatomy of Angiosperm **Credit-4**

Unit-I

Introduction: Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradient, cell fate and cell lineage.

Seed germination & seedling growth: Metabolism of proteins and mobilization of reserves food and tropism. seedling growth. Hormonal control of seedling growth, gene-expression, use of mutants in understanding seedling development. (15hrs)

Unit-II

Shoot development: SAM organization, cytological and molecular analysis of SAM, stem cell in plants, primary and secondary tissue differentiation, xylem and phloem, secretary ducts, lacticifers, wood development in relation to environmental factors. (15hrs)

Unit-III

Leaf growth and differentiation: Inception, phyllotaxy, leaf forms (leaf meristems and other factors) differentiation of epidermis, stomata, trichomes, mesophyll, kranz anatomy, leaf trace, leaf gap, transfer cells.

Flower development: Floral meristem, genetics of floral organ differentiation, homeotic mutants in *Arabidopsis* and *Antirrhinum.* (15hrs)

Unit-IV

Root development: RAM organization, vascular tissue differentiation, lateral roots, root hairs, root microbe interaction.

Seed coat development: external and internal morphology of seed, seed appendages, ontogeny of seed coat, mature structure, spermoderm patterns. (15hrs)

Suggested laboratory / field exercises

1. Study of living shoot apices by dissecting using plants such as *Tabernae-montana, Albizia.*
2. Study of cytohistological zonation in shoot apical meristem (SAM) in sectioned and double stained Permanent slide of slide of a suitable plant. Examination of shoot apices in a monocotyledon in both T.S and L.S. to show the origin and arrangement of leaf primordial.
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 natural condition as well as by GA treatment. Microscopic examination of vertical section of leaves such as *Eucalyptus, Ficus, Mango, Nerium, Maize,* Grass andWheattounderstandtheinternalstructureofleaftissues Andtrichomes,glandsetc. study the leaf anatomy C3 and C4 of plants.
4. Study of epidermal peel of leaves such as *Coccinia, Tradescantia* etc.to study thedevelopment and final structure of stomata and prepare stomatal index.
5. Study of types of stomata in plants belonging to different families.
6. Study of whole roots in monocots and dicots.
7. Examination of LS . of root from a permanent prepration to understand the organization of root apical meristem and its derivative .(use *Maize,* aerial root of banyanetc.)
8. Study of lateral root development.
9. Study of leguminous roots with different types of nodules.
10. Study of primary and secondary tissue differentiation in rootsand shoots.

11. Study of seed coat types – Pisum, Cucurbita, and Wheat.

12. Study of vascular tissues by clearing technique.

Suggested Reading:

1. Atwll,B.J.Kriedcrmann,P.F.and Jumbull,C.G.N.(eds.)1999.Plants in Actions:adaptation in nature performance in cultivation. MacMillan Education,Sydney
2. Bewley.J.D.Black,M.1994Seeds:Psychology of development and Germination,PlenumPress,NewYork
3. Burgess,J1985,An Introduction to plant cell development.Cambridge Univ.Press
4. Fahn,A. 1982 PlantAnatomy(3_{rd}edition)pergamon Press,Oxford.NewYork
5. Raven,P.H.,Evrt.R.F.and Eichhorn.S.1992 BiologyofPlants(5_{th}edition)Worth,NewYork
6. Salisbury P.B.andRossC.W.1992Plant Physiology(4_{th}edition)Wadsworth Publishing,California
7. Steeves,T.A.andSussexI.M.1989Patternsin Plant Development(2_{nd}edition) Cambridge Univ.Press
8. Waisel Y., Eshel, A. and Kafkaki. U. (eds.) 1996 Plants Roots: The Hidden hall (2_{nd} edition) Marcel Dekker, NewYork

MBOT: 304 (A)
Advanced Plant Pathology I

Credit-4

Unit-I

Plant pathology: History and scope, symptoms of plant disease (caused by pathogens and environmental factors). Host factor in disease development, Environment factors in plant diseases. host parasite interaction, transmission, inoculum potential, enzymes, effector and toxin in plant disease. Effect of pathogen on plant physiological functions (15hrs)

Unit-II

Symptomlogy, Identifiaction and control of following plant diseases: Fungal disease:- white rust & early blight, Paddy blast,
Leaf rot and foot rot of pan (*Piper beetle*), Red rot of sugarcane, Flax rust.
Bacterial disease: Brown rot of potato, Blight of rice,
Crown Gall disease of stone fruits, Angular leaf spot of cotton. (15hrs)

Unit-III

Phytoplasma Disease: Little leaf of brinjal, Sesame Phyllody.
Plant Galls: Classification, developmental anatomy, host parasite interaction and physiology of insect induced plant galls of Rajasthan- *Pongamia, Cordia, Prosopis and Salvadora*, Economic significance of galls. (15hrs)

Unit-IV

Nematology: General account of nematodal diseases, symptoms, Methods used in Nematology. Control of plant parasitic nematodes. Inter relationship between nematodes and other plant pathogens.
Nematodes Disease: Molya disease of wheat and barley, Soyabean Cyst nematode. (15hrs)

Suggested laboratory exercises:

Histopathology of nematode infected roots Study of following disease:
Red rot of sugarcane Paddy blast
Flax rust
Crown gall disease of stone fruits Angular leaf spot of cotton
Little leaf of brinjal Sesame Phyllody
Galls of Pongamia, *Cordia,Prosopis, Salvadora* ,
Molya disease of wheat and barley
Soyabean cyst nematodes

Suggested Reading:

1. Agrios,G.N. 2005. Plant pathology,5 th 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., Newyork, USA
3. Khan,J.A. and Dijkstra.2002.Plant virus as molecular pathogens. The Haworth Press Inc. USA
4. Mehrotra,R.S. and A.Agrawal.2003 Plant Pathology.2nd Edition TATA Mc Graw Hill. Pub. Company Ltd. New Delhi
5. Singh,R.S.1982 Plant Pathogens:The Fungi.Oxford and IBH Publishing Company,New Delhi,India

6. Singh,R.S.1982 Plant Pathogens:The Prokaryotes. Oxford and IBH Publishing Company,New Delhi,India
7. Trigiano,R.N.,M.T. Windham andA.S. Windham.2008.Plant pathology:Concept and Laboratory Exercise.2nd edition CRC Press.
8. Vidhyasekram,P. 2004.Conise Encyclopedia of plant Pathology.Food product press and Haworth Press Inc. Binghamton.Ne.

MBOT 304 (B)
Seed Science and Technology-I **Credit-4**

Unit-I

History of seed testing and its importance to agriculture, aims of seed testing, Seed definition & its types, Sampling of seeds, purity analysis (physical and genetical), seed moisture content, germination test,rapid test of viability and evaluation, seedling evaluation, various methods of seed separation, cleaning, drying and seed processing plant and its process. (15hrs)

Unit-II

Gross architecture of seed structure of angiosperms, identification and structure of seeds of important crop plants and with special reference to Rajasthan (wheat, pearl millet, mustard, gram pea, spices). Identification of designated objectionable weeds at seed level.

Principles of seed production, seed production in self and cross pollinated crops; hybrid seed production. Production of foundation and certified seeds, synthetic seed, terminator seed technology. (15hrs)

Unit-III

Physiology of seed germination; seed and seedling vigour, seed dormancy and longevity, seed storage methods, principles of safe seed storage, effects of storage, mycotoxins, Deterioration of seeds in storage by micro-organisms, insects and rodents, control of seed deterioration, seed bank.

(15hrs)

Unit-IV

Seed certification standards and quarantine regulations. International cooperation, International Seed Testing Association (I.S.T.A.)- rules and recommendations, certificates, other seed certificates, Indian Seed Act and recent amendments, National and Regional seed Corporation of India- their organization, aims and functions. National and International co-operation in seed pathology. Sanitary and phytosanitary (SPS) agreement of WTO.

(15hrs)

Suggested laboratory exercises:

1. Structure of seeds of some crop plants (wheat,pealmillet, mustard, gram,pea)
2. Common weed seeds in crop seed lots and their identification (*Amaranthus* and *Cynodon*).
3. Study of purity of seedsamples.
4. Study of seed germination, seedling abnormality and seedling index.
5. Determination of moisture content of seeds.
6. TZ test for seed viability.
7. Assays of enzymes in crop seeds.
8. Biochemical testing of starch, protein ,lipids ,tannins ,phenols and lignins in seed sections.
9. Localization of starch, protein, lipids, tannins, phenols and lignins in seed sections.
10. Isolation and identification of storage fungi.
11. Preparation of phyto sanitary certificate etc. of seed lot.

Suggested Readings:

1. Agarwal,V.K. and Sinclair, J.B. (1987). Principles of seed-pathology, II edition CRC Lewis Publishers, Boca Raton, New York,London.
2. Agarwal,R.L.1980.SeedTechnology,Oxfordand IBHPublishingCo.Pvt.Ltd.NewDelhi.
3. Anonymus (1985). International rules for seed testing. International Seed Testing Association (ISTA). Seed Sci. &Tech.
4. Bewley,J.D. and Black, M.1983. Physiology and Biochemistry of seeds in relation to germination, Volume I & II, Springer-Verlag, Berlin, Heidelberg, NewYork.
5. Copeland,L.O. 1976 Principles of Seed Sci. and Technology Minnesota,USA.

6. Kulkarni,G.N.2002.PrinciplesofseedTechnology,KalyaniPublishers,NewDelhi.
7. Neergaard,P. 1986. Seed- A horse of hunger or a source of life.Revised print of Danish Government Institute of seed pathology for Developing Countries, Hellerup,Denmark.
8. Winton, A.L. and Winton, K.B. (1932-1939). The structure and Composition of foods Vol I and II, John Willey and Sons, Inc., NewYork.

MBOT 304 (C)
Advanced Plant Physiology-I **Credit-4**

Unit-I

Proteins and Enzymes: Techniques of protein purification, protein sequencing and proteomics, Enzyme kinetics, Michaelis Menten equation and significance of Km value, negative and positive co-operativity, enzyme nomenclature and E.C. number, Catalytic mechanisms: Acid-Base catalysis, covalent catalysis, metal ion catalysis, electrostatic state bonding, Lysozyme as model enzyme for catalytic mechanism, Regulation of enzyme activity, feedback and allosteric regulation, active sites, coenzymes, activators and inhibitors. (15hrs)

Unit-II

Nucleotides metabolism: Biosynthesis of Ribonucleotides and of Deoxy-ribonucleotides- salvage and denovo pathways, nucleotide degradation.

Vitamins: Water and fat soluble vitamins, biochemical functions of thiamine, riboflavin nicotinic acid, pantothenic acid, pyridoxine, biotin, folic acid, vitamin B12, ascorbic acid, vitamin A and VitaminD.

(15hrs)

Unit-III

Secondary Metabolism: Coumarins and Lignins: structure and synthesis **Insecticides (pyrethrins and rotenoids):** distribution, chemistry andfunction **Tannins**: distribution, synthesis and function
Flavonoids and water soluble pigments: synthesis andfunction
Hallucinogens: distribution, chemistry and function (15hrs)

Unit-IV

Alkaloids: Pyrrole, Pyrrolidine, Pyridine, Poly acetylquinoline,
Tropane and Indole alkaloids- distribution, synthesis and function.
Saponins and Sapogenins: Sterols, Steroids, Steroidal Alkaloids – distribution, synthesis and function.

Cardiac Glycosides: distribution, structure and synthesis (15hrs)

Suggested laboratory exercises:

1. Quantitative estimation of protein using Lowry'smethod
2. Isolation of casein from milk and itsquantification
3. Quantitative estimation of Vit.C
4. Extraction and identification of flavonoids andalkaloidsusingTLC
5. Preliminary detection of Flavonoids, Alkaloids andsteroids

Suggested Readings:

1. Lehninger, A.L., Nelson, D. L., Cox, M.M. Principles of Biochemistry. 3rd edition. Macmillon Publishers Worth New York.2000.
2. Jain,J.L.FundamentalofBiochemistry.2ndedition.Willey,NewYork.1995.
3. Voet, D. and Voet, J.G. Biochemisry 2nd edition. Willey, New York,1995

M.Sc. SEMESTER IV

S. No.	Subject Code	Course Title	Course Category	Credits	EoSE duration (hrs)		EoSE assessment			
					Theory	Practical.	External	Internal	Min. marks	Max. marks.
1.	401	Embryology of Angiosperm	DSC	4	3	0	70	30	40	100
2.	402	Plant Resource Utiliza. and Ethnobotany	DSC	4	3	0	70	30	40	100
3.	403	Plant Biotech. And Genetic Engineering	DSC	4	3	0	70	30	40	100
4.	404 A/B/ C	Adv.Plant Patho. -II / Seed Sci. and Tech.II / Plant Physiology II	DSE	4	3	0	70	30	40	100
5.	451	Practical I based on MBOT 401 & 402	DSCP	6	0	4	60	40	40	100
6.	452 A/B/ C	Practical II based on MBOT 403 & 404 (A/B/C/D) Project work / Dissertation	DSEP	6	0	4	60	40	40	100

Course Outcomes-

MBOT 401-Embryology of Angiosperm-

Student gain knowledge of structure and development of Microspore, male gametophytes, megaspore, female gametophytes

Mode of pollination, self incompatibility, barrier of fertilisation, types of embryo and endosperm, apomixis, parthenocarpy and poly embryony in detail.

MBOT 402-Plant Resource Utilization and Ethnobotany-

Course is better in understanding primary centre and secondary centre of origin of cultivated crops, and wild crops, economic botany of cereal food, fodder, spice and condiments, fibres,eesential oil.

Dyes and pigments, gum and resin, wood, bamboo, rattans and medicinal plants

Processing of beverages, Rubber, ,sugarrcane etc.

Conservation:- In -situ and Ex -situ, National and International organisations of Conservation.

Course provide brief account of ethnobotany.

MBOT 403-Plant Biotechnology and Genetic Engineering

Student understand tissue culture in detail, metabolic engineering and industrial products

Technique of plant transformation, molecular farming of carbohydrates, fat and proteins and basic of bioinformatics.

MBOT 404 - Adv.Plant Pathology-II

Course is best to understand -Plant disease epidemiology and plant disease forecasting, Disease management, Breeding for disease resistance, molecular pathology

MBOT 404- Seed Science and Technology II

course is best in understanding seed borne diseases, seed pathology in detail

MBOT 404- Plant Physiology -II

Student can understand signal transduction in plants, stress physiology, Photobiology, Physiology of flowering and tools and technique used in biochemistry research.

M.Sc. SEMESTER IV

MBOT: 401

Embryology of Angiosperms **Credits-4**

Unit-I

Flower development and differentiation: Flower development, genetics of floral organ differentiation, a homeotic mutant in *Arabidopsis* and *Antirhinum*, Sex determination.

Male Gametophyte: anther structure, microsporogenesis, role of tapetum, pollen development and gene expression, male sterility, sperm dimorphism, hybrid seed production, pollen germination, pollen tube growth and guidance, pollen storage, pollen allergy, pollen embryos.

Female gametophyte: ovule development, megasporogenesis, ultrastructural aspects of embryo sac developmment (15hrs)

Unit-II

Pollination,Pollen pistle interaction and fertilization :Floral characterstics in relation to pollination, Structure of the pistle , fertilization, pollen-pistil interaction, pollen stigma interaction, sporophytic and gametophytic self incompatibility (cytological, biochemical and molecular aspects), double fertilization, invitro fertilization. (15hrs)

Unit-III

Seed development and fruit growth: Endosperm development, embryogenesis, cell lineages during late embryo development. Storage proteins of endosperm and embryo. Polyembryony, apomixis, dynamics of fruit growth, biochemistry & molecular biology of fruit maturation.embryo rescue in wide hybridization,Introduction of embryo culture,endosperm and ovary culture.

(15hrs)

Unit-IV

Latent life, dormancy, types of dormancy, importance, seed dormancy, overcoming seed dormancy, bud dormancy.

Senescence and programmed cell death: Basic Concepts, types of cell death, PCD in life cycle of plants, metabolic changes associated with senescence, influence of hormones, effect of environmental factors on senescence. (15hrs)

Suggested practicals

1. Study of microsporogenesis and gametogenesis insection of anther ofdifferentages.
2. Examnition of mode of anther dehiscence and collection of pollen grains for microscopic examination (maize ,grass, *Ca*nnabis *sativa, crotolaria ,tradescantia , brassica, petunia,Solanum melongena,etc.)*
3. Study of wall layers ofanther.
4. Test for pollen viability using stains and in vitro germination.
5. Pollen germination using hanging drop and sitting drop culture, suspension culture, andsurfaceculture.
6. Estimating percentage and average pollen tube lenth invitro.
7. Study of ovules in cleared preparation.Study of monosporic,bisporic and tetrasporic type of embryo sac development through examination of permanent stained serial section.
8. Field study of several type of flower with different pollinationmechanism.
9. Emasculation, bagging and hand pollination to study pollen germination.
10. Study of nuclear and cellular endosperm through dissection andstaining.
11. Isolation of zygote globular heart shaped torpedo stage and mature embryo fromsuitable seeds.

12. Polyembryonyincitrus,jamun(syzygiumcumini)etc.bydissection.
13. Biochemical estimation(qualitativeandquantitative)of metabolites ofseeds.

Suggested readings:

1. Atwll, B.J. Kriedcrmann, P.F.andJumbull,C.G.N.(eds.)1999PlantsinActions:Adaptationin Nature Performance in cultivation, MacMillan Education, Sydney
2. Bewley. J.D. Black, M. 1994. Seeds: Psychology of development and Germination, Plenum Press, New York
3. BhojwaniS.S.andBhatnagarS.P.2000TheEmbryologyofAngiosperms (4_{th}revised and enlarged edition) Vikas Publishing House, New Delhi
4. Burgess, J. 1985. An Introduction to plant cell development. Cambridge Univ.Press
5. FageriK.and Vander PijlL. 1979ThePrincipleofPollinationEcology.pergamonPress, Oxford
6. Fahn,A.1982PlantAnatomy (3_{rd}edition) pergamonPress, Oxford. NewYork
7. Fosker D.E.1994. Plant Growth and Development. A Molecular Approach. Academic Press San Diego
8. Howell,S.H.1998.PlantGrowthandDevelopment.AMolecularApproachAcademicspress,SanDiego.
9. Leins, P ., Tucker, S.C. and Endress ,P.K. 1988.Aspects of Flora Development ,J. Cramer, Germany.
10. Lyndon, R.F.1990PlantDevelopment, The Cellular Basis, Unnin Byman London
11. Murphy T.M. and ThompsonW.E.1988, Molecular Plant Development Prentice Hall, New Jersey
12. ProcterM. and Yeo. P. 1973 The Pollination Of Flowers. William Collins Sons,London
13. Raghvan V.1997 Molecular Embryology of Flowering plants .Cambridge University PressCambridge
14. Raghvan V. 1999 Developmental Biology Of Flowering Plants ,Springer –Verlag,Newyork
15. Raven. P.H., Evrt. R.I. and Eichhorn. S. 1992 Biology Of Plants (5_{th} edition) Worth, NewYork
16. SalisburyP.B.andRossC.W.1992PlantPhysiology(4_{th}edition)WadsworthPublishing,California
17. Steeves,T.A.andSussexI.M.1989PatternsinPlantDevelopment(2_{nd}edition)CambridgeUniv.Press, Cambridge
18. Sdgley,M.AndGriffin, A.R. 1989Sexual Reproductionto TreeCrops.Academicpress,London
19. ShivannaK.R.andSawhneyVK,(eds)1997PollenBiotechnologyForCropProduction and Improvement, Cambridge University,Cambridge
20. Shivanna K.R. Rangaswamy , N.S. 1992 Pollen Biology : A Laboratory ManualSpringer – Verlag ,Berlin
21. ShivannaK.R.andJohriB.M.1995,AnAngiospermsPollen:StructureAndFunction.WileyEasternLtd. NewYork
22. The Plant Cell Special Issue On Reproductive Biology Of Plants Vol. 5 (10)1993

MBOT 402
Plant Resource Utilization & Ethnobotany **Credits- 4**

Unit-I

Origin, evolution, Botany, cultivation and uses of: (i) Food, forage and fodder crops,

(ii) fiber crops, (iii) medicinal and aromatic plants (iv) fruits and vegetables (iv) spices and condiments (v) oil yielding crops. (15 Hrs.)

Unit-II

Plants used as avenue trees for shade, pollution control and aesthetics.
ornamental plants, plants used in sericulture, petro crops, in narcotics, as mastigatories, fumitories and Important fire-wood and timber-yielding plants and non-wood forest products (NWFPs) such as bamboos and rattans. Raw materials for paper making, gums, tannins, dyes and resins.

(15 Hrs.)

UNIT-III

Plant Biodiversity: Concept, status in India, utilization and concerns.
World's primary centers of origin of cultivated plants, secondary centers. Plant introductions and acclimatization.
Principles of conservation: Extinctions, environmental status of plants based on International Union for Conservation of Nature (IUCN)
Strategies for conservation – in situ conservation: International efforts and Indian initiatives, protected areas in India – sanctuaries, national parks, biosphere reserves, wetlands, mangroves and coral reefs, conservation of wild biodiversity.
Strategies for conservation – ex situ conservation: Principles and practices, botanical gardens. Field gene banks, Seed banks, in vitro repositories and cryobanks.

(15 Hrs.)

Unit-IV

General account of the activities of Botanical Survey of India (BSI), National Bureau of plant Genetic Resources (NBPGR), Indian Council of Agriculture Research (ICAR), Council of Scientific and Industrial Research (CSIR), and the Department of Biotechnology (DBT) for conservation and non formal conservation efforts. (10 hrs.)

Ethnobotany: History,development and scope of ethnobotanical study, Interdisciplinary approaches, ethinic groups of India, Applied Ethnobotany: role of ethanobotany in national priorities, health care and development of cottage industries in India.

(5 Hrs.)

Suggested Laboratory Exercises
The practical course is divided into three units (1) Laboratory work, (2) Field survey and (3) Scientific visits

Laboratory Work

1. Food crops: Wheat, rice, maize, chickpea (Bengal gram), Potato, Sweat Potato, Sugarcane: Morphology, anatomy, Biochemical tests for stored food materials
2. Forage fodder crops: Study of any five important crops of the locally available (for example fodder, sorghum, Bajra, khejari Ardu, Zizyphus
3. Plant fiber: Cotton, Jute, hemp, sunn hemp, *Cannabis*, Kapok: Morphology anatomy, microscopic study of whole fibre using-approriate staining procedure.

Medicinal and aromatic Plants: Depending on the geographical location location; *Papaver somniferum, Catharanthus roseus, Adhatoda cylanica, Allium sativum, Rauwolfia serpentine, Withania somnifera, Phyllanthus amarus, P. fratermus, Andrographis paniculata, Aloe Berbadadens, Mentha arvensis, Rosa spp. Pogostemon cablin, Origamom vulgare, Vetiveria zizinoides.*

4. Study of live or herbarium specimens or other visual materials to become familiar with these resources.
5. Vegetable oils: Mustard, groundnut, Soyabean, coconut, sunflower, castor. Morphology, microscopic structure of the oil yielding tissues. test for oil and iodine number.
6. Gum, resins, tannins, dyes: perform simple test for gums and resins. Prepare a water extract of vegetable tannins (*Acacia, Terminalia*, tea, *Cassia* spp.) and dyes (Turmeric, Indigo, Butea, lawsonia) and perform test to understand their chemical nature.
7. Firewood and timber yielding plants.

Field survey-

1. Prepare a short list of 10 most important sources of fire wood and timber in your locality. Give their local names, scientific names and families to which they belong. Mention their properties.
2. A survey of a part of the town or city should be carried out by the entire class to make the student aware about the vegetation characteristics of particular area in city or town.

Scientific visits

The students should be taken to one of the following:

1. A Protected area (Biosphere reserve, National park and Sanctuary)
2. A Wetland
3. Mangroove

Suggested Readings

1. Anonymous 1997. National Gene Bank: Indian Heritage on Plant Genetic Resources (Booklet). National Bureau of Plant Genetic Resources, New Delhi.
2. Arora, R.K. and Nayar, E.R. 1984. Wild Relatives of Crop Plants in India. NBPGR Science Monograph No. 7.
3. Baker, H.G. 1978. Plants and Civilization (3rd edn.) C.A. Wadsworth, Belmont. 41.
4. Bole, P.V. and Vaghani, Y.1986. Field Guide to Common Indian Trees. Oxford Unviersity Press, Mumbai.
5. Chandel, K.P.S., Shukla, G. and Sharma, N. 1996. Biodiversity in Medicinal and Aromatic plans in India: Conservation and Utilization. National Bureau of Plant Genetic Resources, New Delhi.
6. Chrispeels, M.J. and Sadava, D. 1977. Plants, Food and People, W.H. Freeman and Co. San Francisco.
7. Cristi, B.R. (ed.) 1999. CRC Handbook of Plant Sciences and Agriculture. Vol. I. In situ conservation. CRC Press, Boca Raton, Florida, USA.
8. Conway, G. 1999. The Doubly Green Revolution: Food for Allinthe21st Century. Penguin Books.
9. Conway, G. and Barbier, E. 1990. After the Green Revolution. Earth scan Press, London.
10. Conway, G.and Barbief, E. 1994. Plant. Genes and Agriculture. Jones and Bartlett Publishers, Boston.
11. Council of Scientific and Industrial Research 1986. The Useful Plants of India. Publications and Information Directorate, CSIR, New Delhi.
12. Council of Scientific and Industrial Research (1948-1976). The Wealth of India. A Dictionary of Indian Raw Materials and Industrial Products. New Delhi. Raw Materials I-XII, Revised Vol. I-III (1985-1992) Supplement (2000).
13. Cronquist, A. 1981. An Integrated System of Classification of Flowering plants. Columbia University Press, New York, USA.
14. Directory of Indian Wetlands, 1993. WWF INDIA, New Delhi and AWB, Kuala Lumpur.
15. Falk,D.A., Olwel, M. and Millan C.1996. Restoring Diversity, Island Press, Columbia, USA.
16. FAO/IBPGR 1989. Technical Guidelines for the Safe Movement of Germplasm. FAO/IBPGR, Rome.
17. Frankel, O.H., Brown, A.H.D. and Burdon, J.J. 1995. The Conservation of Plant Diversity. Cambridge University Press, Cambridge, U.K.
18. Gadgil, M. and Guha, R. 1996. Ecology and Equity: Use and Abuse of Nature in Contemporary India. Penguin, New Delhi.
19. Gaston, K.J. (Ed.) Biodiversity: a Biology of Numbers and Differences. Blackwell Science Ltd., Oxford, U.K.
20. Heywood, V. (Ed.) 1995. Global Biodiversity Assessment. United Nations Environment Programme.

Cambridge University Press, Cambridge, U.K.42.
21. Heywood, V.H. and Wyse Lackn, P.S. (Eds.) 1991. Tropical botanical Gardens. Their Role in Conservation and Development. Academic Press, San Diego.
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23. Kothari,A. 1997. Understanding Biodiversity: Life Sustainability and Equity. Orient Longman.
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26. Paroda, R.S. and Arora, R.K. (1991). Plant Genetic Resources Conservation and Management. IPGRI (Publication) South Asia Office, C/o NBPGR. Pusa Campus, New Delhi.
27. Pimentel, D. and Hall, C.W.(Eds.)1989. Food and Natural Resources, Academic Press, London, New York.
28. Pinstrup-Anderson, P. et al. 1999. World Food Prospects: Critical Issues for the Early 21st Century. International Food Policy Research Institute. Washington D.C., USA.
29. PlantWealthofIndia1997.Special Issue of Proceedings IndianNationalScienceAcademyB-63.
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31. Rodgrs, N.A. and Panwar, H.S. 1988. Planning a Wildlife Protected Area Network in India. Vol. I. The Report. Wildlife Institute of India, Dehradun.
32. Sahni, K.C. 2900. The Book of Indian Trees. 2ndedition. Oxford Unviersity Press, Mumbai.
33. Schery, R.W. 1972. Plants for Man. 2nd ed. Engle woodCliffs, New Jersey. Prentice Hall.
34. Sharma, O.P. 1996. Hill's Economic Botany (Late Dr. A.F. Hill, adapted by O.P. Sharma). Tata McGraw Hill Co. Ltd., New Delhi.
35. Swaminathan, M.S. and Kocchar, S.L.(Eds.) 1989. Plants and Society. Macmillan Publication Ltd., London.
36. Thakur, R.S., Puri, H.S. and Husain, A. 1989. Major Medicinal Plants of India. Central Instituteof Medicinal and Aromatic Plants, CSIR, Lucknow.
37. Thuomas, P. 2000. Trees: Their National History. Cambridge University Press, Cambridge.
38. Wanger, H., Hikino, H. and Franswarth, N. 1989. Economic and Medicinal Plant Research. Vol. 1-3. Academic Press, London.
39. Walter, K.S. and Gillett, H.J. 1998. 1997 IUCN Red List of Threatened Plants. IUCN, the World Conservation Union, IUCN, Gland, Switzerland and Cambridge, U.K.

MBOT 403

Plant Biotechnology and Genetic Engineering **Credits- 4**

UNIT-I

Plant tissue culture: Principles and concept, history, general methodology, culture media ingredients, preparation methods of sterilization and disinfestations, aseptic techniques and preparation of explant, micropropagation in plants, shoot morphogenesis and organogenesis, callus and suspension cultures, microspore culture for producing haploids and their importance. Somatic embryogenesis: Principles, concepts and applications. Protoplast technology- isolation methods, purification, viability tests, culture, plating efficiency, somatic cell hybridization, selection of protoplast fusion hybrids, somaclonal variation, production of secondary metabolites. Overview of plant tissue culture applications.

(15hrs)

UNIT-II

Metabolic Engineering and Industrial Products: Basic concept of metabolic engineering, strategies used in metabolic engineering, biotransformation, cell permealisation, elicitation hairy roots, media manipulation, manipulation of phenylpropanoids / Shikimic pathway, production of industrial enzymes, biodegradable plastics, biopolymers and antibiotics.

Vectors for plant transformation: Basic features of vectors (Promoters, terminators and sequences influencing gene expression, selectable markers & reporter gene, origin of replication. Co-integrative and binary vector for plant transformation), codon optimization.

(15hrs)

UNIT-III

Techniques for plant transformation. Biology of *Agrobacterium. Agrobacterium* mediated gene transfer, process of T-DNA transfer and integration, practical applications of *Agrobacterium* mediated gene transfer. Application of DNA based molecular markers (RFLP, RAPD, AFLP) in plant biotechnology, genome editing, TALE, CRISPR. Heterologous gene expression in plants and genetic manipulation of plants for herbicide tolerance, insect resistance, Stress tolerance, disease resistance, improvement of crop yield and quality (Post harvest loses, longer shelf life of fruits and flowers, color manipulation of flower, making of golden rice**).** (15hrs)

UNIT-IV

Molecular farming for carbohydrates, lipids and proteins (Edible vaccines and Oleosin system.

Science and society: Public acceptance of genetically modified crops (Publūic concerns, current status of transgenic crop, regulation of GM crops, Cisgenic crops and products). Introduction to Intellactual Property. Biosafety guidelines. Environmental release of GMO's. Risk analysis, Risk assessment, Risk management.

Introduction to bioinformatics: Definition, history, applications and scope. Biological databases and sequence analysis. BLAST and FASTA. Multiple sequence alignment, phylogenetic analysis and bioinformatics in drug discovery. Bioinformatics in India. (15hrs)

Suggested laboratory exercises:

1. Preparation of Media
2. Surface sterilization
3. Micropropagation Technique
4. Organ Culture
5. Callus Propagation, organogenesis and transfer of plants to soil

6. Anther Culture and Production of Haploids
7. Preparation of Synthetic seeds
8. Cytological examination of regenerated plants
9. Isolation of protoplasts from various plant tissues and testing their viability
10. PCR and Gel Electrophoresis
11. Techniques : Biolistics, Membrane Filtration and Cell Counting
12. Hairy root cultures
13. Extraction of alkaloids and flavonoids from plant materials and their separationusing TLC.
14. BLAST
15. FASTA

Suggested readings:

1. J. Hammond, P. McGarvey. Plant Biotechnology. Springer Verlab.2000.
2. H.S.Chawla.BiotechnologyinCropImprovement.InternationalBookDistributingCompany.1998
3. R.J.Henry.PracticalApplicationinPlantMolecularBiology.Chapmanand Hall.1997
4. P.K. Gupta. Plant Biotechnology. Rastogi and Co. Merrut.2010.
5. Bhojwani, S.S. and Rajdan, M. K. 1996. Plant Tissue Culture. Theory and Practice (A Revised edition). Elsevier Science Publication, New York,USA.
6. MetabolicEngineering.Stephenopoulos,Arisitidou,A.A.andNeilson,J.AcademicPress
7. BioprocessEngineering. Shuler,M.I.andKargi,F.PHIprivateLearningLtd.,NewDelhi..
8. Basic Biotechnology. Ratledge, C. ,Kristainsen, B. CambridgePublication.

MBOT 404 (A)

Advanced Plant Pathology II Credits-4

Unit-I

Plant disease epidemiology and plant disease forecasting: Concept in epidemiology, Computer simulation of epidemics, Role of environment and meteorological factor in the development of plant diseases epidemics. methods used in plant forecast, examples of plant disease forecasting system.

(15hrs)

Unit-II

Disease management: Principles and economics, regulatory methods, cultural practices and physical methods, chemical treatment, biological control, integrated approach and future prospects, responses of traditional and nontraditional plant growth regulators to plant disease and management.

(15 Hrs.)

Unit-III

Breeding for disease resistance: Variability in organisms, Type of host resistance (Non host specific, true resistant and apparent resistant), General account and production of disease resistant plant. Integrated pest management. Host pathogen specificity and responses.

(15 Hrs.)

Unit-IV

Molecular plant pathology: Molecular diagnosis, identification of genes and specific molecules in disease development, genetics of host pathogen interaction, Molecular mechanism of resistance.

Application of biotechnology and information technology in plant pathology.

(15hrs)

Suggested laboratory exercises-

1. Biochemistry- alternated plant physiology due to plant pathogen interaction.
2. Biochemistry of altered metabolites- protein, lipids, starch, cellulose peroxidases and poly phenol oxidase.
3. Virus detection through biological (indicator hosts and hosts range) and serological methods (elisa. Immunudiffusion) Virus indexing
4. Methods of application of fungicides- seed and foliar application
5. Bio-control of plant pathogen- dual culturetechnique.
6. Bioassay of fungicides poison food technique. Inhibition zone technique and slide germination technique.

Suggested Reading:

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. Khan J.A. and J. Dijsktra 2002 Plant Virus as Molecular Pathogens. The Haworth Press Inc. USA
4. Mehrotra, R.S. and A. Agrawal 2003 Plant Pathology 2nd Edition Tata McGraw hill Pub. Company Ltd. New Delhi
5. Singh R.S.1982 Plath Pathogens: The Fungi Oxford and IBH Publ. Company New Delhi

6. Singh R.S.1982 Plath Pathogens: The prokaryotes Oxford and IBH Publ. Company New Delhi
7. Trigiano R.N… M.T. Windham and A.S. Windham 2008 Plant pathology: Concepts and Laboratory Exercises. 2nd Edition C.R.C Press
8. Vidhyasekaran, P. 2004 Concise Encyclopedia Of Plant Pathology. Food Product Press. Bingham

MBOT 404 (B)
Seed Science and Technology-II **Credits-4**

Unit-I

Introduction and importance of seed pathology in modern agriculture, History of Seed Pathology, Various methods for testing seed borne fungi, bacteria and viruses (Dry seed examination, seed washing test, incubation methods, cultural, biochemical, serological, nucleic acid-based methods).

(15hrs)

Unit-II

Mechanism of seed infection and its types, environment influencing seed infection, infected/ contaminated part of seed, morphology and anatomy of seeds in relation to invasion, location inoculum of the pathogen in seed-seedcoat and pericarp, endosperm, perisperm and embryo.

(15hrs)

Unit-III

Seed borne diseases of some important crops with particular reference to the state of Rajasthan and India. Typical case of infection by: fungi (Wheat- smut and bunts, sesame-charcoal rot); bacteria (Brassicas- black rot, cluster bean-bacterial blight); viruses (tomato mosaic virus, pea seed bone mosaic virus) and nematodes (Wheat-ear cockle, rice-whitetip).

(15hrs)

Unit-IV

Transmission of seed borne disease: systemic and non-systemic seed transmission, types of disease transmission, mode of establishment and course of disease from seed to seedling and plant, factors affecting seed transmission.

Management of seed-borne disease, principles of control, seed treatments (Physical, Chemical and Biological), mechanism of action of seed treatments, major seed treatments for important seed borne pathogens and their methods of application. (15hrs)

List of suggested practical exercises:

1. Dry seed examination of seed lots.
2. Isolation and identification of seed borne mycoflora by standard blotter method.
3. Preparation of culture media (PDAand NA).
4. Plating seeds on PDA/NA for identification of seed borne fungi and bacteria.
5. Other methods of plating eg. Deep freezing, 2, 4-D blotter method.
6. Water agar test tube seedling symptom test.
7. Study of any seed borne nematode disease.
8. Detection of bacterial and viral pathogens in seeds.
9. LOPAT test for detection of seed borne bacteria.
10. Nucleic acid based detection of seed borne pathogens.
11. Histopathology of infected seed samples.
12. Physical control of seed-bornepathogens.
13. Antibiotic/fungicidal assay against seed-borne pathogens.
14. Biological control of seed borne pathogens.
15. Field visits: Crop fields, FCI, NSC, Seed Testing Labs, Quarantine station, (eg. NBPGR) etc.

Suggested readings:

1. Agarwal, P. C., Mortensen, C. N. And Mathur, S.B. 1989. Seed borne diseases and seed health testing of rice. Technical Bull. No. 3. Danish government institute of seed pathology for developing countries (DGISP), Copenhagen and CAB International Mycological Institute, (CMI)UK.
2. Agarwal, V.K.2006.Seed Health. International Book Distributing Company. Charbagh, Lucknow,

India.
3. Agarwal, V. K. and Sinclair, J. B. 1987. Principles of seed pathology. II edition CRC Lewi Publishers, Boca Raton, New York, London.
4. Agarwal, R.L.1980. Seed Technology. Oxford and IBH Publishing Co. Pvt. Ltd. NewDelhi
5. Agrios, G. N. 2005. Plant Pathology. Academic Press, London, New York.
6. Cliffton, A.1958. Introduction to the bacteria. McGraw Hill Book Co. New York.
7. Anonymous (1985,2014). International rules for seed testing. International Seed Testing Association ISTA.
8. Khare, D. and Bhale, M.S. 2014. Seed Technology. Scientific Publishers (India), Jodhpur. Revised 2nd Ed.
9. Mandahar,C. L.1978.Introductiontoplantviruses.S.Chand &Co.Ltd.,Delhi.
10. Mathur, S. B. and Cunfer, B. M. 1993. Seed borne diseases and seed health testing of wheat. Danish Government Institute of Seed Pathology for developing countries. Hellerup, Denmark.
11. Neergard,P. 1977. Seed Pathology. Vol. I&II. The Mac Millan Press Ltd. London.
12. Rangaswamy, G. & Mahadevan, A. 1999. Diseases of crop plants in India (4th edition). Prentice Hill of India, Pvt. New Delhi.
13. Richardson, M. J. 1990. An annotated list of seed borne diseases 4th edition. Proc. Int. Seed Test Assoc. Zurich, Switzerland.
14. Schaad, N. W. 1980. Laboratory guide for identification of Plant Pathogenic bacteria (edt.). Bacteriology committee of American Phytopathological Society), St. Paul, Minnesota.
15. Schaad, N. W. 1988. Laboratory guide for identification of Plant Pathogenic bacteria (2nd eds.). APS Press (The American Phytopathological Society), St. Paul, Minnesota.
16. Singh, D. and Mathur, S. B. 2004. Histopathology of seed borne infections. CRC Press, Boca Raton, London, New York, Washington DC. P p296.
17. Singh, K. G. and Manalo, P. L. 1986. Plant quarantine and Phytosanitory Barriers in the Asean. Asean Plant Quarantine Centre and Training Institute, Malaysia

MBOT 404 (C)
Plant Physiology-II Credits-4

Unit-I

Signal transduction in plants: Receptors and G-Proteins, phospholipid signalling, role of cyclic nucleotides, calcium- calmodulin cascade, diversity of protein kinases and phosphatase, signal transduction mechanism with special reference to Actin-cytoskeleton signal transduction, sugar induced signal transduction. (15hrs)

Unit-II

Stress physiology: Types of stress and physiological consequences, Response and resistance mechanisms, Molecular mechanism of tolerance, Stress tolerant Transgenics. Heat stress and heat shock proteins, Osmotic adjustments, Reactive oxygen species and oxidative stress, Metal toxicity. Biotic stress and response, HR and SAR mechanisms.

Photobiology: Photoreceptors, Phytochrome: History, discovery, physiological properties, interaction between hormone sand phytochromes, role of different phytochromes in plant development and flowering. Cryptochrome sand Phototropins. (15hrs)

Unit-III

Physiology of Flowering: Photoperiodism and vernalization. Biological clock. Physiology of seed dormancy, senescence and abscisions**.**

Circadian rhythms in plants: Nature of oscillator, rhythmic outputs, entertainments (inputs) and adaptive significance. (15hrs)

Unit-IV

Tools and Techniques: Principles and application of Spectrophotometry, principle of chromatography: Partition chromatography, Thin layer chromatography, column chromatography-ion exchange chromatography, gas liquid chromatography, high performance liquid chromatography, gel filtration, electrophoresis, ultra- centrifugation (velocity and density gradient), ELISA and RIA. (15hrs)

Suggested laboratory exercises:

1. Study of effect of PEG induced stress on seed germination
2. Effect of Red and Infra-red light on seed germination and study ofphotomorphogenesis
3. Hormonal regulation of leaves and petals senescence
4. To study the rhythmic movements in plants
5. Study of changes in protein and starch content during seed development
6. Separation techniques: Spectropotmetry, chromatography, electrophoresis, ultra-centrifugation, ELISA

Suggested Readings:

1. Kumar, A. and Purohit, S. S. 1996. Plant physiology: Fundamentals and applications. Agro botanical Publishers, Jodhpur.
2. Pandey, S.N. and Sinha, B. K. 1995. Plant Physiology. Vikas Publishing House, New Delhi.
3. Steward, F. C. 1959. Plant Physiology. Vol. 2, Academic Press, New York.