SYLLABUS

M.Sc. BOTANY

(ANNUAL SCHEME)

M.Sc. (Previous) Examination 2020
M.Sc. (Final) Examination 2021
M.Sc. Previous

Paper I  Cell & Molecular Biology of Plants
Paper II  Cytology, Genetics & Cytogenetics
Paper III Biology & Diversity of Lower Plants: Cryptogams
Paper IV Taxonomy & Diversity of Seed Plants
Paper V  Plant Physiology & Metabolism
Paper VI  Microbiology and Plant Pathology

M.Sc. Final

Paper VII Plant Morphology, Developmental Anatomy and Reproductive Biology
Paper VIII Plant Ecology
Paper IX  Plant Resource Utilization & Conservation
Paper X  Biotechnology & Genetic Engineering of Plants & Microbes
Paper XI  Elective I
Paper XII Elective II

Elective Papers XI & XII

Papers XI (a) : Advanced Plant Pathology I
Paper XII (a) : Advance Plant Pathology II

OR

Papers XI (b) : Seed Science and Technology I
Paper XII (b) : Seed Science and Technology II

OR

Papers XI (c) : Ecosystem Ecology
Papers XI (d) : Advanced Plant Physiology I
Paper XII (d) : Advanced Plant Physiology II

OR

Papers XI (e) : Advanced Morphology and Morphogenesis-I
Paper XII (e) : Advanced Morphology and Morphogenesis-II

OR

Papers XI (f) : Biosystematics of Angiosperms I
Paper XII (f) : Biosystematics of Angiosperms II

OR

Papers XI (g) : Biotechnology-I
Paper XII (g) : Biotechnology-II
M.Sc. Botany

M.Sc. (Previous)

There will be six papers in theory, each of three hours duration, 100 marks each and two practicals carrying 150 marks each (10% marks are reserved for viva and 15% marks for records in each examination). Each practical examination will be of 6 hours duration to be completed in one day.

Each theory paper will have 9 questions, out of which a student has to attempt 5 questions and the question No. 1 will be compulsory. The question No. 1 will carry 20 marks and will be of short type of questions with a limit of 20 words.

M.Sc. (Final)

There will be six papers, four compulsory and two elective in theory of 3 hours duration carrying 100 marks each and two practicals each as follows:

i. Practical for compulsory papers of 200 marks of 8 hours duration to be completed in two days.

ii. Practical for elective papers of 100 marks of 4 hours duration to be completed in one day.

Each theory paper will have 9 questions, out of which a student has to attempt 5 questions and the question No. 1 will be compulsory. The question No. 1 will carry 20 marks and will be of short type of questions with a limit of 20 words.

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There will be a question paper of 100 marks of three hours duration. 100 marks are distributted as follows:
- Paper I: Dichotomous Key
- Paper II: Cryptogams
- Paper III: Biology and Biotechnology
- Paper IV: Theories and Diversity of Crop Plants
- Paper V: Plant Physiology and Plant Anatomy
- Paper VI: Microbiology and Plant Pathology

Scheme of Examination
Max. Marks: 100
The paper will have 9 questions, out of which 5 questions to attempt 5 questions including the question 1, which will be compulsory.

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petroy. The question will carry five marks. Each of several short objective questions will carry one mark. Choose only.

Unit-1

The dynamic role of microtubules, the gen cell specialisation plate movements, chemotaxis segregation, and polarisation.

Tissue studies: the anatomy.

Unit-2

Cells and their parts: The inner structure and cell behaviour in multicellular systems in animal and plant systems.

Unit-3

Cell organelle specialisation: The structure and function of organelles in plant and animal systems. Different organelles and their functions, size, and location.

Other cellular specialisations: Microbody, lysosomes, endoplasmic reticulum.
Mycology: General characteristics of fungi; mycelial growth; basidiospores and spores; reproduction; life history; ecological significance; economic importance; pharmacological and mycological aspects. Mycopathology, fungous diseases, and their control.

Bryophyta: Bryology, morphology, anatomy, reproduction, ecology; Jungermanniales, Anthocerotaceae, Marchantiaceae, and Polytaeniaceae, with special reference to Adiantum, Nephrolepis, and Polytrichum; economic and medical importance.

Recent advances in Mycology: Modern approaches to mycology; recent developments in fungal genetics; fungal systematics; fungal diversity; fungal evolution; fungal biotechnology; fungal ecology; fungal biogeochemistry.


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TAIPUR
Unit I

Introduction: Gymnosperms, the vessel-less and fruitless seed plants varying in the structure of their spores, pollen grains, pollen germination and the complexity of their female gametophyte.

Evolution of Gymnosperms: Classification of Gymnosperms and their distribution in India.

Brief account of the families of Pteridospermales (Lygnopteridaceae, Medullosaceae, Caytoniaceae and Glossopteridaceae). General account of Cycadeoids and Cordaitales

Structure and reproduction in Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales and Gnetales.

Unit II

TAXONOMY OF ANGIOSPERMS

1. Aims, components, and principles of Taxonomy: Alpha and Omega Taxonomy, documentation and scope.

2. Systems of Angiosperm classification: Cronquist, Dahlgren, Thorne and APG-II.

   Taxonomic concept: Hierarchy, species, genus, family and other categories.

Unit III

Numerical Taxonomy- Principles, concepts, operational taxonomic units (OTU), data processing and taxonomic studies, taxometric methods for study of population variation and similarity- coding, cluster analysis, cladistics. cladogram.


Taxonomic tools and techniques: Herbarium, serological, Molecular technique, GIS and Mapping biodiversity.
Unit IV

Taxonomic evidences: Morphology, Anatomy, Palynology, Embryology, Cytology, Phytochemistry and Genome analysis.

Phylogeny of Angiosperms: Ancestors of Angiosperms, time and place of origin of Angiosperms, habit of Angiosperm, primitive living Angiosperms, inter relationship among the major group of Angiosperms.
Suggested Readings

Hieman Educational Book Ltd., London.

Suggested Laboratory Exercises

Gymnosperms
2. Study of important fossil gymnosperms from preserved slides and specimens.
Angiosperms

3. Description of a specimen from representative, locally available families

List of Locally Available Families:


4. Description of a species based on various specimens to study intraspecific variation: a collective exercise.

5. Description of various species of a genus; location of key characters and preparation of keys at generic level.

6. Location of key characters and use of keys at family level.

7. 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.

8. Training in using floras and herbaria for identification of specimens described in the class.

9. Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.

10. Comparison of different species of a genus and different genera of a family to calculate similarity coefficients and preparation of dendrograms.
Each paper will have 9 questions, out of which 5 will be compulsory and 4 optional. The compulsory questions will carry 30 marks and the optional questions will carry 20 marks.

1. Enzyme - Structure, Properties, Classification, Function and Mechanism of catalysis.

Note: All questions will be based on the textbook "Physiology and Metabolism" by Dr. Smith.


Plants growth regulators - cytokinins, indoleacetic acid, growth regulators, gibberellins - chemical nature, biochemistry, physiological effects, mode of action, gibberellins - growth promoters, physiological effects and mode of action, cytokinins - growth suppressors, physiological effects and mode of action, physiological effects, homeostasis, and metabolization.

Suggested Readings:
4. Design the procedure for isolation and quantification of three major forms of chlorophyll and chlorophyll a.
5. To designate the molar extinction coefficients by Qy
6. Isolation of homogenates and estimation of chlorophylls by procedure not given.
7. Compatibility of the homogenate with various chlorophylls.

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body specificity of seedling and its color, and mechanism of disease

treatment and its cultural aspects.

Plant disease management: Disease biological and ecological aspects, development of resistance, molecular and biochemical mechanisms, physiological basis, and use of biocontrol agents.

Unit IV

Identification and control of following plant diseases.

1. Tomato yellow leaf curl virus
2. Tomato mosaic virus
3. Potato late blight
4. Potato scab

References:

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<table>
<thead>
<tr>
<th>Questions</th>
<th>Marks</th>
</tr>
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<tbody>
<tr>
<td>1. Describe the material in question. Assign it to the relevant family.</td>
<td>5</td>
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**Skeleton Paper**

**L.E.C. (Previous)-Group-I Practical Examination**

**Time**: 4 Hours

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<thead>
<tr>
<th>QNo.</th>
<th>Question</th>
<th>Marks</th>
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<tr>
<td>1</td>
<td>a) Predict the given molecular weight</td>
<td>16</td>
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<td>b) Perform the given exercise of salt analysis</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>a) Predict the given compound</td>
<td>15</td>
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<tr>
<td></td>
<td>b) Perform the given exercise of salt analysis</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>a) Identify the given compound</td>
<td>15</td>
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<td></td>
<td>b) Draw the Lewis structure diagram of the molecule</td>
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<td>c) Describe the physical properties of the compound</td>
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(b) Prepare an artificial key of the given plant materials (A, B & C):

(c) Make a suitable preparation of material Z:

- Identify it giving reasons.
- Perform the physiology experiments as assigned to you. Describe the methodology and record your observations.
- Prepare a suitable slide of the given physiological exercise. Draw diagrams, describe methodology and record your observations.
- (i) Prepare the microbiological exercise properly. Draw diagrams, describe methodology and record your observations.
- (ii) Prepare suitable slide of the given microbiological exercise. Draw diagrams, describe methodology and record your observations.

**Course Schedule**

- Paper XII: Microbiology and Biotechnology--I
- Paper XIII: Environmental Science
- Paper XIV: Advanced Biotechnology--I
- Paper XV: Advanced Biotechnology--II
- Paper XVI: Advanced Biotechnology--III
- Paper XVII: Biotechnology
- Paper XVIII: Biotechnology
- Paper XIX: Biotechnology
- Paper XX: Biotechnology

**Registration**

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& REPRODUCTIVE BIOLOGY

Unit I
Introduction: Unique features of plant development, differences between animal and plant development
Seed germination and seedling growth: Metabolism of proteins and mobilization of food reserves, tropisms during seed germination and seedling growth, hormonal control of seedling growth, gene expression, use of mutants in understanding seedling development.

Shoot development: Organization of the shoot apical meristem (SAM), cytological and molecular analysis of SAM, control of cell division and cell to cell communication, Primary and Secondary tissue differentiation, control of tissue differentiation, especially xylem and phloem, secretory ducts and laticifers, wood development in relation to environmental factors.

Unit II
Leaf growth and differentiation: Inception, phyllotaxy, control of leaf form (leaf meristems and other factors), differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll, kranz anatomy, Leaf traces and leaf gaps, transfer cells.

Root development: Organization of root apical meristem (RAM), vascular tissue differentiation, lateral roots, root hairs, root-microbe interactions.
Seed coat development: External and internal morphology of seed, seed appendages, ontogeny of seed coat in various families, mature structure, spermoderm patterns.

Unit III
Reproduction: Vegetative options and sexual reproduction, flower development, genetics of floral organ differentiation, homeotic mutants in Arabidopsis and Antirrhinum, sex determination
Male gametophyte: Structure of anthers, microsporogenesis, role of tapetum, pollen development and gene expression, male sterility, sperm dimorphism and hybrid seed production, pollen germination, pollen tube growth and guidance, pollen storage, pollen allergy, pollen embryos.

Female gametophyte: Ovule development, megasporogenesis, organization of the embryo sac, structure of the embryo sac cells.

Pollination, pollen-pistil interaction and fertilization: Floral characteristics, pollination mechanisms and vectors, structure of the pistil, pollen-stigma interactions, sporophytic and gametophytic self-incompatibility (cytological, biochemical and molecular aspects), double fertilization, in vitro fertilization.

Unit IV

Seed development and fruit growth: Endosperm development, embryogenesis, cell lineages during late embryo development, storage proteins of endosperm and embryo

Polyembryony, apomixis, embryo culture, dynamics of fruit growth, biochemistry and molecular biology of fruit maturation.

Latent life - dormancy: importance and types of dormancy, seed dormancy, overcoming seed dormancy, bud dormancy.

Senescence and programmed cell death (PCD): Basic concepts, types of cell death, PCD in the life cycle of plants, metabolic changes associated with senescence and its regulation, influence of hormones and environmental factors on senescence.

Suggested Readings:
New York.
Belmont, California

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Suggested Laboratory/Field Exercises

1. Study of living shoot apices by dissections using plants such as *Tabernaeanthana, Albitzia*
2. Study of cytological zonation in the shoot apical meristem (SAM) in sectioned and double-stained permanent slides 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 primordia.
3. Study of alternate and distichous, alternate and superposed, opposite and superposed, opposite and decussate leaf arrangement. Examination of rosette plants (*Launaea, Mollugo, Raphanus, Hyoscyamus* etc.) and induction of bolting under natural conditions as well as by GA treatment.
4. Microscopic examination of vertical sections of leaves such as *Eucalyptus, Ficus, Mango, Nerium, maize, grass and wheat* to understand the internal structure of leaf tissues and trichomes, glands etc. Also study the leaf anatomy C3 and C4 of plants.
5. Study of epidermal peels of leaves such as *Coccinia, Tradescantia, etc.* to study the development and final structure of stomata and prepare stomatal index.
6. Study of types of stomata in plants belonging to different families.
7. Study of whole roots in monocots and dicots.
8. Examination of L.S. of root from a permanent preparation to understand the organization of root apical meristem and its derivatives. (use maize, aerial roots of banyan etc.)
9. Study of lateral root development.
10. Study of leguminous roots with different types of nodules.
11. Study of primary and secondary tissue differentiation in roots and shoots.
12. Study of seed coat types - *Pisum, Cucurbita, wheat*.
13. Study of vascular tissues by clearing technique.
14. Study of microsporogenesis and gametogenesis in sections of anthers of different ages.
15. Examination of modes of anther dehiscence and exfoliation of pollen grains for microscopic examination (maize, grasses, *Cannabis sativa, Crotalaria, Tradescantia, Brassica, Petunia, Solanum melongena*, etc.)
17. Tests for pollen viability using stains and in vitro germination.
18. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
20. Study of ovules in cleared preparations, study of monosporic, bisporic and tetrasporic types of embryos; development through examination of permanent, stained serial sections.
21. Field study of several types of flower with different pollination mechanisms.
22. Emasculation, bagging and hand pollination to study pollen germination.
23. Study of nuclear and cellular endosperm through dissections and staining.
24. Isolation of zygotic globular, heart-shaped, torpedo stage and mature embryos from suitable seeds.
25. Polyembryony in citrus, jamun (Syzygium cumini) etc. by dissections.
26. Biochemical estimation (qualitative and quantitative) of metabolites of seeds.

Suggested Readings. (For Laboratory Exercises)
Unit I

Science of Ecology: Introduction to ecology, evolutionary ecology, ecological models.
Population: Characteristics of population, population size and exponential growth, limits of population growth, population dynamics, life history pattern, fertility rate and age structure, population growth. Competition and coexistence, intra-specific interactions, interspecific interactions, scramble and contest competition model, mutualism, commensalism and allelopathy, prey-predator interactions.

Vegetation organization: Concepts of community and continuum, community coefficients, interspecific associations, ordination, species diversity and pattern diversity in community, concept of habitat and ecotone, ecological niche.

Unit II

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

Ecosystems: Nature and size of ecosystem, components of an ecosystem (producers, consumers and decomposers), Grazing (grassland) and Detritus food chain in freshwater ecosystems, food webs, Ecological energetic: Solar radiation and energy intakes at the earth’s surface, energy flow models. Productivity of various ecosystems of the world and global biogeochemical cycles of carbon and nitrogen. Ecosystem services

Unit III

Ecosystem stability: Concept (resistance and resilience), ecological perturbations (natural and anthropogenic) and their impact on plant and ecosystems. Restoration of degraded ecosystems, ecology of plant invasion. Environmental impact assessment, ecosystem restoration

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Biomes. Biodiversity: Major biomes of the world and Impact of changing climate on biomes. Biodiversity: Concept & level. role of biodiversity in ecosystem function and stability, assessment (local, national and global), speciation and extinction, Biodiversity act of India and related international conventions, diversity indices, IUCN Categories of threat, Hot spots.

Unit IV
Conservation: Conservation (ex-situ and in situ) and management, International Conservational organizations, sustainable development, natural resource management in changing environment, molecular ecology, genetic analysis of single and multiple population, molecular approach to behavioural ecology, conservation genetics.


Suggested Readings

Unit IX


Suggested Readings:


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Suggested Laboratory Exercises

1. To determine minimum size and number of quadrats required for reliable estimate of biomass in grasslands.
2. To compare protected and unprotected grassland using some community indices (similarity indices).
3. To estimate IVM of the species in a grassland-woodland using quadrat method.
4. To determine gross 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 the dissolved oxygen content in eutrophic and oligotrophic water samples by a modified version of Waldler’s method.
9. To determine chlorophyll content in NO.1 harvested and unharvested plants leaves.
10. To study the rate of carbon dioxide evolution from different treatments using a respiration method.

(Rajasthan University)
Paper :- IX
Plan: Restored Utilization and Conservation
Scheme of Examination
Max. Marks: 10
Each paper will have 10 questions, out of which a student has to attempt 5 questions, and the remaining 5 questions will be compulsory. The marks will be carried by 20 marks and will be of even
Short objective type of questions, such as multiple choice-type, open
free response type, or fill in the blanks type, etc.

Unit 1
- Plan Biodiversity: Concepts, Places: India, utilization and
concerns.

Unit 2
Sustainable Development: Basic Concepts, Origins of agriculture.
- World centres of primary diversity of domesticated plants
The Indo-Burmese Centre, plural introductions and secondary centres

Unit III
- Origins, cultivation, botanical cultivation and uses of: (i) Food
  crops and fodder crops, (ii) fibre crops, (iii) medicinal and aromatic
  plants, and (iv) vegetable oil-yielding crops

Unit IV
- Important fire-wood and timber-yielding plants and non-wood
  forest products (NWFPs): such as bamboo, rattan, raw
  materials for paper making, gums, tanning, dyes, resins and fruits.
- Green Revolution: Benefits and adverse consequences, Impacts
  tests for meeting world food demands.

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Date: [Signature]
Plants used as avenue trees for shade, pollution control and aesthetics: Principles of conservation, existing/conventional and emerging strategies of plants based on International Union for Conservation of Nature.

Strategies for conservation—ex situ conservation: IUCN criteria and methods; ex situ methods; in situ methods; reservoirs; ex situ collections; ex situ collections in India; National Parks, Biosphere Reserves, Wetlands, Marine Parks and other initiatives of conservation of wild biodiversity.

Selected Readings
Nair, M.N.B. et al. (Eds.) 1988. Sustainable Management of Non-Timber Forests. Faculty of Forestry, University of Malaya, Kuala Lumpur, Malaysia.


Suggested Laboratory Exercises

1. The practical course is divided into three units: (1) laboratory work, (2) field survey, and (3) scientific visits.

Laboratory Work

Food Crops: Wheat, rice, maize, chickpea (Bengal gram), potato, tapioca, sweet potato, tobacco, sunflower, soybean, microthermal tests for stored food materials.

Fonsecaea recta: Study of causes of diseases in the locality (for example: food-borne, bean, potato blight, gus bean, grass, Ficus sp.)

Plant Fibres:
(a) Textile fibres: cotton, jute, linen, horse hair, rabbit hair.
(b) Cordage fibres: jute.
(c) Fibres for knitting: silk cotton or kapok.

Morphology and anatomy: Study of the following using appropriate staining procedures:
- Medicinal and aromatic plants (D. pendula) from an ethnophar- maceutical location. (Select five, noting the wild only if they are abundantly available.)
- Papaver somniferum, Citrus sinensis, Cinnamomum zeylanicum, Achiote sementes (Carthamus tinctorius), Allium sativum, Eupatorium perfoliatum, Withania somnifera, Phyllanthus emblica, Aegle marmelos, Andrographis paniculata, Agave americana, Ruscus sp., Pueraria lobata, Gnetum gnemon, Eucommia ulmoides, Jatropha curcas, Ricinus communis, Pongamia pinnata.

Study of five or ten hundred specimens or other stored materials, to become familiar with these resources.

2. Vegetable Oils: Mustard, groundnut, soybean, coconut, sunflower, castor. Morphology, microscopic appearance of the oil-yielding tissues, tests for oil and iodine uptake.

- Oils, resins, turpentine, drugs: Perform microscopic tests for gums and resins. Prepare a waxy extract of vegetable oil. Prepare a waxy extract of vegetable oil. Prepare a waxy extract of vegetable oil. Prepare a waxy extract of vegetable oil. Prepare a waxy extract of vegetable oil. Prepare a waxy extract of vegetable oil.

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Serve

Prepare a short list of 10 most important sources of firewood and timber in your locality. Give their local names, scientific names, and families to which they belong. Mention their properties.

Prepare an inventory of the bamboos and rattans of your area giving their scientific and local names and their various uses with appropriate illustrations.

A survey of a part of the town or city should be carried out by the students in their locality. Individual students will take under their personal responsibility and locate the trees which are important. They will identify the type, position, their size, category, shape, flowering and fruiting period and their status (healthy, diseased, infected, damaged, missed or dry). The reports should be sent to the concerned authority in which they are studying and also to the Individual students will be concluded and Davis in the form of a report, which can be used by the concerned authorities by the next batch of students and also to community NGOs and civic authorities. The purpose of exercise in item C above is to make the students aware of the kinds of trees and their role in entire ecosystems and ecological services.

Visit

Students should be taken to one of the following:

- A protected area (biosphere reserve, national park, or a sanctuary)
- A mangrove
- National Bureau of Plant Genetic Resources, New Delhi
- Any of its field stations
- Head Quarters of the Botanical Survey of India or one of its Regional Circles
- A CSIR Laboratory doing research on plants and their utilization
- An ICAR Research Institute or a field station dealing with some major crop or crops
- A recognised ecological group or a museum (such as those at the York Research Institute, Dehradun, National Botanical...
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Institute, Lucknow. Tropical Research Garden and Research Station, Tribhuvan.), which has collection of plant products.

Note: The students are expected to prepare a brief illustrated narrative of the field survey and scientific visits. After evaluation, the grades awarded to the students by the teachers should be added to the field assessment of the practical examination.

Paper X: Biotechnology and Genetic Engineering of Plants and Microbes

Scheme of Examination
Max. Marks: 100
Each paper will have 8 questions, out of which a student has to attempt 5 questions including the question No. 1 which will be compulsory. The question No. 1 will carry 20 marks and will be of short answer type. Questions may be multiple choice type, one or more correct answers type, and fill in the blanks type.

Unit I
Biotechnology: Basic concepts, principles and scope

Unit II
Plant Cell and Tissue culture: General introduction, history, scope, concept of cellular differentiation, tissue culture.
Organogenesis and adventitious embryogenesis: Fundamental aspects of morphogenesis: somatic embryogenesis and androcytogenesis, mechanisms, techniques, and utility.

Unit III
Somatic hybridization: Protoplast isolation, fusion and culture, hybrid selection and regeneration, possibilities, limitations and limitations of protoplasts research.
Applications of plant tissue culture: Callus propagation, artificial seed, production of hybrids and somaclones, production of secondary metabolites/natural products, cryopreservation and germplasm bank.
Recombinant DNA technology: Gene cloning, principles and techniques, construction of plasmids and vectors; choice of vector, DNA synthesis and sequencing, polymerase chain reaction, DNA finger printing.

Genetic engineering of plants: Aims strategies for development of transgenics (with suitable examples), Agrobacterium-mediated natural genetic engineering, T-DNA and transposon-mediated gene transfer, chloroplast transformation and its utility, intellectual property.

Unit-II


Environmental factors in disease development: Epiphytotics and plant disease forecasting.

Unit-III

IPM, Application of biotechnology and information technology in pest management.

Molecular Plant Pathology: Molecular diagnosis, identification of genes and specific molecules in disease development, molecular manipulation of resistance. Non-parasitic diseases and control measures.

Unit-IV

Principle of Plant Protection, Physical, Chemical and biological control of plant diseases.

Classification and anatomy of galls: Some insect induced plant galls of Rajasthan, mechanism and physiology of insect galls.

Paper-XII (a): Advanced Plant Pathology-II

Scheme of Examination

Max. Marks: 100

Each paper will have 9 questions, out of which a student has to attempt 5 questions including the question No. 1 which will be compulsory. The question No. 1 will carry 20 marks and will be of several short objective type of questions such as multiple-choice type, one-line answer type, one-word type and fill-in-the-blanks type.

Unit-I


Unit-II

Bacteria: Classification and nomenclature of bacterial plant
pathogens. Methods of identification of bacterial pathologies, physiology, serology and pathogenicity.


Unit-III

Virus, viroid and phytoplasma disease: Symptomatology and transmission of viral diseases; Potato virus X & Y, Tomato ring blight, bunchy top of banana; viroids and important viroid diseases. Phytoplasma General account; Sesame phyllody, Spike disease of cotton.

Unit-IV

Nematology: Brief history, classification and identification of pathogenic nematodes. Morphology and anatomy of nematodes.

Control of plant parasitic nematodes. Nematode Disease: A disease of wheat & barley, ear cockle of wheat, root-knot

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Unit I
History of seed testing and its importance to agriculture, aims of seed testing, Seed- definition and 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.

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

Unit III
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, Seed storage methods, principles for safe seed storage, effects of storage, mycotoxins- major groups, detection and detoxification, Deterioration of seeds in storage by micro-organisms, insects and rodents; control of seed deterioration.

Unit IV
Seed certification standards and quarantine regulations. International cooperation, International Seed Testing Association - Rules and recommendations, Certificates, other seed certificates; Indian Seeds Act and recent amendments, National and Regional Seed Corporations of India - their organisation, aims and functions. National and International Co-operation in Seed Pathology. Sanitary and phytosanitary (SPS) agreements of WTO.

List of suggested Practical exercises:

1. Structure of seeds of some crop plants (wheat, pearl millet, mustard, gram, and pea).
2. Preparation of inventory of designated objectionable weeds at seed level and identification.
3. Identification of seed coat cracking.
4. Study of physical purity of seed sample.
5. Study of seed germination, seedling abnormality and seedling index.
6. Determination of moisture content of seeds.
7. TZ test for seed viability
10. Localization of starch, protein, lipids, tannins, phenols and lignin in seed sections.
11. Isolation and identification of storage fungi.
12. Preparation of phytosanitary certificate etc. of seed lot.

Suggested Readings:


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).

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 of inoculum of the pathogen in seed- seed coat and pericarp, endosperm and perisperm and embryo.

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

Unit III

Seed-borne inoculum, inoculum density and assessment of seed borne inoculum in relation to plant infection, epiphytotics due to seed borne inoculum, disease forecast based on infected seed samples, tolerance limits of seed borne pathogens.

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.

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Unit IV

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.

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 (PDA and NA).
4. Plating seeds on PDA/NA for identification of seed borne fungi and bacteria.
5. Other methods of plating e.g. deep freezing; 2,4D- blotter method.
7. Study of any seed borne nematode disease.
8. Detection of bacterial and viral pathogens in seeds.
9. LOPAT tests 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-borne pathogens.
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 (e.g. NBPGR) etc.

Suggested Readings:


Paper XI (C): Ecosystem Ecology

Unit I
Grassland Ecosystems - Characteristics of grasslands, stratification, grasslands and grazing, grasslands and drought, grassland and animal life, Grasslands types with special reference to Prairie and Savannah, Indian grasslands.

Forest Ecosystems - Stratification of the forest, Forest types - Boreal, Temperate and Tropical forests, Forest animal life

Unit II

Marine and Estuarine Ecosystems - Characteristics of marine environment: Salinity, Temperature and pressure, Zonation and Stratification, Tides, Estuarine ecosystem: Types of Estuaries, Flora and fauna, Estuarine productivity, Coral reef ecosystem, Mangrove ecosystem

Unit III
Urban Ecosystem - Urban environment and Climatic conditions, additional physical complexes modified surfaces including parking lots, roofs, and landscaping, buildings, transportation networks, infrastructure and public amenities), flora and fauna (human beings as largest consumer), Implications of urbanization: problems of air pollutants, drinking water supply, waste, waste disposal.

Rural ecosystems: Rural environment and climate, physical complexes (fields, agricultural elements and machines), Flora and fauna, Problems of discharge of chemical fertilizers, pesticides and drinking water. Management of waste, Principle; Social Forestry.
Unit IV

Desert Ecosystem: Definition, classification (hot and cold), physiography, desert features, flora, fauna and water, formation, topography, distribution and characteristics of world deserts; Thar desert: Sand dunes: types, origin and morphology of sand dunes; Vegetation types and plant communities, biological production, conservation of flora and fauna, wild life, Succession in vegetation of Western Rajasthan and coastal sand dunes, economic importance of desert plants (general economic plants, medicinal, famine food plants and crops); Saline Arid zones: saline tracts of Rajasthan and plants of saline arid zones (Halophytes), Economic and social considerations in the management of salt affected soils, afforestation in salt affected soils, Importance of halophytes.

Suggested Readings


Suggested Laboratory Exercises

1. Find out stomatal index of Xerophytes (Nerium, Calotropis, Zizyphus,) growing in your locality.
   Study of trichomes of xerophytes (Zizyphus, Lantana, Calotropis, Aerva) growing in your locality.
   Study spread of root system of a perennial species in the soil
   Study ecological adaptations of halophytes in your nearby area.
5. Seed Viability by T.T.C. method
6. Dormancy in seeds
7. Soil moisture and temperature at different depths
8. Salinity of soil sample.
9. Study of Canopy and Basal Cover of trees in your study area
10. Estimate primary productivity of a water body by light and dark bottle method
11. Mean leaf area of 2 plant Species growing in your area by graph method
12. Relative humidity by hair hygrometer
13. Light intensity by lux meter
Air Pollution: Important Primary (CO, CO₂, Particulates, Odour Producing compounds); Primary Photochemical reaction, Formation of air pollutants on Buildings & Monuments, pollution control (particulates and gaseous pollutants depletion, control strategies;

Unit II

Water Pollution: Eutrophication- Process and Control; Oil Pollution, Thermal Pollution, Heavy metal Pollution, Treatment, Disposal & Recycling of Wastewaters, drinking water standards

Solid & Hazardous waste management & collection, Shrinking waste streams: 3Rs (Reduce, Reuse, Recycle), demolition, disposal: Land fill, Open dumps, Exporting waste; Resource Recovery: Solid wastes, Types, action, Recycle & Reuse), composting, energy

Unit III

Climate Issues: Greenhouse gases (CO₂, CH₄, consequence of greenhouse effects (CO₂ for Biodiversity erosion), Carbon footprints, Carbon Sensing technology in environmental studies, the
Policies, Regulations & related issues: Water (Prevention and Control of Pollution) Act 1974; 
Air (Prevention and Control of Pollution) Act 1981; Environment (Protection) Act 1986, Wild 

Unit IV

Environmental concerns: Environment auditing, Ecological footprints, Environment Impact 
Assessment, Bioindicator and biomarkers of environmental health; Environmental economics, 
Ecopolitics and green policies; Ecolabel, Rain water harvesting, Orans, Indira Gandhi Canal and 
its ecological implication, water logging & salinity problems- The management alternatives.

Suggested Readings

Ltd., Publishers, New Delhi.
Publications, Jaipur
7. I.P.Abrol amd V.V. Dhruva Narayana (Editors) 1990. Technologies for Wasteland 
Development. ICAR, New Delhi.
8. G. M. Masters and W. P. Ela. 2008. Introduction to Environmental Engineering and 
Sciences. PHI Learning Private Limited, New Delhi.
Publisher, Jaipur.

suggested Laboratory Exercises

(c)
1. To estimate pH, EC and Secchi Disc transparency for polluted and unpolluted water bodies.
2. To estimate Chemical Oxygen Demand of polluted water sample.
3. To estimate Biological Oxygen Demand of polluted water sample.
4. To estimate inorganic phosphorus content in water samples collected from polluted and unpolluted water bodies.
5. To estimate Total hardness, calcium and magnesium content in water samples collected from polluted and unpolluted water bodies.
6. To estimate chloride content in water samples collected from polluted and unpolluted water bodies.
7. To estimate Total alkalinity in water samples collected from polluted and unpolluted water bodies.
8. To determine diversity indices (Shannon-Wiener, concentration of dominance, species richness, equitability and β-diversity) for polluted and unpolluted water bodies.
9. Chlorophyll content of plant species growing in polluted (along JLN Marg) and unpolluted habitat (Botany Department).
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 cooperativity, enzyme nomenclature and EC number, catalytic mechanisms, acid-base catalysis, covalent catalysis, metal ion catalysis, electrostatic catalysis, catalysis through proximity-orientation effect of catalysis through transition state bonding, lysozyme as model enzyme for catalytic mechanism, regulation of enzyme activity, feed and allosteric regulation, active sites, coenzymes, activators and inhibitors, isoenzymes, ribozymes and abzymes.

Unit-II
Nucleotides: Biosynthesis of ribonucleotides (purines and pyrimidines), formation of deoxyribonucleotides, salvage purines, nucleotide degradation.

Vitamins: Water and fat-soluble vitamins, biochemical function of thiamine, riboflavin, nicotinic acid, pantothenic acid, pyridoxin, ascorbic acid, vitamin B₁₂, biotin, vitamin A and vitamin D.

Unit-III
Secondary Metabolites:

Carotenoids and lignins: Structure and synthesis.
Triterpenoids: (pyrrolizidine and triterpenoids) distribution, chemistry, function.
Tannins: distribution, synthesis and function.
Flavonoids and water-soluble pigments: Synthesis and function.

Haloalkanes: Distribution, chemistry and function.

Unit-IV
Alkaloids: Pyrrole, pyrrolidine, pyridine, polyaacetylindoline, tropane and indole alkaloids—distribution, synthesis and function.
Saponins and sapogenins: Sterols, steroids, steroidal alkaloids—distribution, synthesis and function.
Cardiac glycosides: Their distribution, structure and function.

Paper-XII (d): Advanced Plant Physiology—II
Scheme of Examination: Max. Marks: 100
Each paper will have 9 questions, out of which a student has to attempt 5 questions including the question No. 1 which will be compulsory.

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pulsory. The question No.1 will carry 20 marks and will be of several
short objective-type of questions such as multiple-choice-type, one
down-answer-type, one word-type and fill-in-the-blanks type.

Unit-I

Plant growth regulators: Natural and synthetic, biochemistry and
physiological effects of brassinosteroids, jasmonic acid, salicylic
acid, polyamines, morphactins and cyanogenic compounds.

Signal transduction in plants: Receptors and G-protein,
phospholipid signalling, role of cyclic nucleotides, calcium-calmodulin,
cascade, diversity of protein kinases and phosphatases, signal
transduction mechanisms with special reference to: Gibberellin in-
duced signal transduction, auxin induced signal transduction and
cytokinin induced signal transduction.

Unit-II

Stress physiology: Plant responses to biotic and abiotic stresses,
mechanism of biotic and abiotic stress resistance, plant defense,
mechanisms against water stress, salinity stress, metal toxicity, freez-
ing and heat stress and oxidative stress.

Unit-III

Photorhology-Photoperiod, Phytochrome: history, discovery,
physiological properties, interaction between hormones, and
phytochrome, role of different phytochromes in plant development
and flowering, mechanism of phytochrome signal transduction. Physi-
ology of flowering photo-periodism and vernalisation.

Circadian rhythms in plants-Nature of oscillator, rhythmic
outputs, entrainments (inputs) and adaptive significance.

Unit-IV

Tools and Techniques: Principles and application of
spectrophotometry, Principles of chromatography, partition chroma-
tography, thin layer chromatography, ion-exchange chromatography,
gas-liquid chromatography, high performance liquid chromatography,
gel filtration, electrophoresis, isoelectric focusing, immobilized pH
gradient, ultra centrifugation (velocity and density gradient), ELISA
and RIA.

Paper-XI (c) : Advanced Morphology and Morphogenesis-1

Schemes of Examination

Max. Marks: 100

Each paper will have 9 questions, out of which a student has to
attempt 5 questions including the question, No. 1, which will be com-

Unit-II


Unit-III

Embryogenesis-Basic types and thesis-interrelationships, structural aspects of embryogenesis. Endosperm—In relationship of the major types of endosperm, morphology and role in embryo development. Embryo—Major types, embryogenic laws; comparison of Souques and Johanson's system; physiological factors controlling growth and differentiation of embryo.

Unit-IV

Apomixis—genogenesis, androgenesis, agronomic importance. Embryological features of the following families: Santalaceae, Anarthriceae, Podostemaceae, Cucurbitaceae, Scrophulariaceae, Orobanchaceae, Lentibulariaceae.

Syllabus: MSc. Botany - 51

Unit-I

Each paper will have 9 questions, out of which a student has to answer 8 questions including the question which will be compulsory. The question No. 1 will carry 20 marks and will be of different objective type of questions such as multiple-choice type, one-word type and fill-in-the-blanks type with a limit of 20 words.

Unit-I

Development and morphogenesis—shoot apex: the apical cell,
meristem, the subcellular and biochemical structure of the meristem. The mechanism of primordia initiation transition to flowering, growth and formation of organs. Experimental work on apical meristem, meristem culture and virus free plant, histochemical studies on apical meristems.

Unit-II
The phenomenon of morphogenesis-correlation, polarity, symmetry, differentiation, regeneration.

Unit-III
Somatic embryogenesis—survey of somatic embryogenesis in angiosperms, direct somatic embryogenesis and embryogenesis from callus and protoplasts, cytology, physiology and genetics of somatic embryogenesis nutritional factors, hormonal factors and embryoid rescue in wide hybridization.
Micropropagation advances and synthetic seeds.
Cell plating technique and isolation of mutant cell lines; auxotrophic mutants.
Mechanism involved in cell culture mutants.
Suspension culture and growth studies.

Unit-IV
Microtechniques for plant cultures. Fixation (FAA and glutaraldehyde) and embedding in paraffin and GMA, equipment and histological procedures. Transmission and scanning electron microscopy for plant protoplasts and cultured cells and tissues. Endosperm and ovary culture, control of fertilization; experimental work on embryology of parasitic plants. Role of plant tissue culture in crop improvement.

Paper-XX (i) : Biosystematics of Angiosperms-I
Schemes of Examination

Max. Marks: 80

Each paper will have 9 questions, out of which a student has to attempt 5 questions including the question No. 1 which will be compulsory. The question No. 1 will carry 20 marks and will be of various short objective-type of questions such as multiple choice-type, one line answer-type, one word type and fill in the blanks type with a limit of 20 words.

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Unit-I
The components and principles of taxonomy. Alpha and Omega taxonomy, documentation, scope, significance and relationship of experimental and orthodox taxonomy. Evolutionary taxonomic classification.

Unit-II

Unit-III

Unit-IV

Paper-XII (I) : Biosystematics of Angiosperms
Schemes of Examination
Max. Marks: 100
Each paper will have 9 questions, out of which a student has to attempt 5 questions including the question No. 1 which will be compulsory. The question No. 1 will carry 20 marks and will be of several short objective type of questions such as multiple-choice type, one-word answer type, one-word type and fill-in-the-blanks type, with a limit of 20 words.

Unit-I

Unit-II
Concept of species, speciation, species classification. Concept of characters—analytic versus synthetic character, qualitative versus quantitative characters, good and bad characters. Taxonomic charac-
ter—Character weighing. Characters variation, its role in speciation and isolation.

Unit-III

Concept of population, its significance, pattern of phenetic variability, Geographical variability, Transplant experiments. Genotype—environmental interaction, Plasticity, Variation—cause of variation in population, Range of tolerance and phenotypic plasticity, Ecotypes—origin and differentiation, Taxonomic significance of ecotypes.

Unit-IV

Experimental taxonomy and hybridization, Role of hybridization in evolution, Stabilization of hybrids and amphidiploidy, introgression and segregation.


Suggested Readings:

Paper-XI (p) : Biotechnology-I

Scheme of Examination

Max. Marks : 100

Each paper will have 9 questions, out of which a student has to attempt 5 questions including the question No.1 which will be compulsory. The question No.1 will carry 20 marks and will be of several short objective type of questions such as multiple choice type, one line answer type, one word type and fill in the blanks type.

Unit-I

The concept of totipotency and history of development of plant tissue culture from Haberlandt to the present development of different PTC media and their nutritional components.

Plant tissue culture laboratory—facilities, operation and management, media preparation and handling; Sterile techniques.

Unit-II

Pathways of plant regeneration—proliferation of auxillary buds, adventitious shoot bud proliferation, organogenesis and somatic embryogenesis from callus and suspension cultures.


Unit-III


Isolation and culture of protoplasts of grasses review of work done with special reference to rice, wheat and maize.

Propagation of ornamental plants by tissue culture. Application of tissue culture in forestry.

Micropropagation advances and synthetics seeds, use of ELISA methods to certify pathogen free plants.

Unit-IV

Quantification of tissue culture procedures fresh and dry weight culture density by cell count, packed cell volume mitotic index.

Microtechniques for plant cultures—fixation (FAA and glutaraldehyde) and embedding in paraffin and GMA, equipment and histological procedures. Transmission and scanning electron microscopy for plant protoplasts, cells and tissues.

Staining procedures for chromosome analysis.

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Paper-XII (e) : Biotechnology-II

Scheme of Examination

Max. Marks : 100

Each paper will have 9 questions, out of which a student has to attempt 5 questions including the question No.1 which will be compulsory. The question No.1 will carry 20 marks and will be of several short-objective type of questions such as multiple choice type, one line answer type, one word type and fill in the blanks type.

Unit-I

Transgenic plants—the concept and history of developments of transgenesis in plants.

*Agrobacterium*—mediated transformation.

Unit-II

Direct DNA transfer into intact plants cells—microprojectile, bombardment and chemical uptake of DNA by plant protoplasts.

Tools for genetic transformation—Transformation vectors, promoters, terminators and markers and reporter genes.

Unit-III

Regulation of heterologous gene expression—factors affecting gene expression, introns, plants transcriptional factors, gene silencing, antisense RNA.

Transgenic approaches to crop improvement—protection against biotic (virus, fungi, bacteria, nematode, insect; weed) and abiotic stress (salinity, drought, cold, metals), Nutritional quality improvement—golden rice and other developments. Extension of flower life, pigmentation and fragrance.

Unit-IV

Manufacture of valuable products—antigens, antibodies, edible vaccines, enzymes, proteins.

Benefits and risks of producing transgenic plants—IPR and regulatory requirements, field testing and regulations to release transgenic plants in India.

Skeleton Paper

M.Sc. (Final) Special Paper Adv., Plant Pathology

Practical Examination

Time : 4 hours

M.M. : 100

Q.No. Questions Marks allotted

1. (a) Study the diseased plant material 'A'; provided; make histopathological investigations.

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Draw labelled drawing and identify the pathogen giving reasons. 10
(b) Study and identify the mycoflora from the given material. 5

2. Give suitable drawings make a suitable preparation so as to study the given material 'C' identify giving reasons. 10

3. Study the external morphology, histopathology and development stages of given material 'D'. Draw labelled diagrams. Identify the causal organism. 10

4. Calibrate your microscope with the help of micrometers and measure spores and determine the mean size. 10

5. From given plant material isolate virus free plantlet through apical meristem culture. Briefly describe the procedure. 8

6. Stain the given bacterial sample and identify it as gram positive or negative. Write in brief the procedure adopted. 10

7. Viva-Voce. 10

8. Spots (Four) 12

9. Practical record. 15

Skeleton Paper

M.Sc. (Final) Special Paper—Seed Technology and Seed Pathology

Practical Examination

Time: 4 hours M.M.: 100

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<thead>
<tr>
<th>Q.No.</th>
<th>Questions</th>
<th>Marks allotted</th>
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<tbody>
<tr>
<td>1.</td>
<td>Study the morphological and anatomical features of given seeds.</td>
<td>20</td>
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<tr>
<td>2.</td>
<td>Study the seed-borne mycoflora of given seed sample</td>
<td>25</td>
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<tr>
<td>3.</td>
<td>Determine the location of pathogen in different components of given symptomatic seeds. or Estimate the spore load in given seed sample.</td>
<td>10</td>
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<tr>
<td>4.</td>
<td>Examine the viability of seed lot. or Study the transmission of pathogen in infected seedling.</td>
<td>10</td>
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