UNIVERSITY OF RAJASTHAN
JAIPUR

SYLLABUS

M.Sc. BOTANY

(ANNUAL SCHEME)

M.Sc. (Previous) Examination 2019
M.Sc. (Final) Examination 2020

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR
M.Sc. (BOTANY)
M.Sc. (ANNUAL PATTERN)

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% 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-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.
M.Sc. (Final)

There will be two papers, each of three hours duration, carrying 100 marks each, in addition to the practical examination. Each paper will be of 4 hours duration, to be completed in the day.

Each theory paper will have 15 long answer type questions, out of which the candidate has to attempt 5. The question set will contain 5 short answer type questions. The question set will be of two types: short answer type and long answer type.

M.Sc. (Final)

There will be six papers, two of theory and four of practical, each of 4 hours duration, carrying 100 marks each, in addition to the practical. The papers will be of the following types:

- Practical: 60 marks, to be completed in 3 hours.
- Theory: 40 marks, to be completed in 1 hour.

Each theory paper will have 5 long answer type questions, out of which the candidate has to attempt 2. The question set will contain 3 short answer type questions. The question set will be of two types: short answer type and long answer type.

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

Scheme of Examination

Max. Marks: 100

The paper will have 9 questions, out of which 4 students have to attempt 3 questions including the question No. 1, which will be compulsory.
Unit I

The dynamic cell: Structural organization of the plant cell, specialized plant cell types, chemical composition, biochemical processes.

Plasmalemma and tonoplast: Membrane structure, functions, and roles.

Nucleus: DNA replication, transcription, and functions in cell growth.

Ribosomes: Synthesis of proteins, protein synthesis in plant cells.

Mitochondria: Energy production and roles in plant physiology.

Vacuoles: Storage and regulation of solutes, functions in cell turgor and cell wall formation.

Cell cycle and division: Control mechanisms, roles of cell division and growth processes, cytokinesis and cell wall formation, mechanisms of cytoplasmic cell division.

Other Cellular organelles: Plastids and functions of chloroplasts, Golgi apparatus, lysosomes, endoplasmic reticulum.
The cultivation of cell biology and molecular techniques, in situ hybridization to locate transcripts in cell types, FISH, GISH, confocal microscopy.

Selected References:

See the following:
- Current Advances Method in Molecular Biology.
- Trends in Plant Science.

Supposed laboratory experiments:
1. Isolation of total RNA, and the activity of ribosomal enzyme.
2. Isolation of different subunits by SDS-PAGE.
3. Isolation of nuclear RNA by gel electrophoresis.
4. Isolation of plant DNA and its quantitation by spectrophotometric method.
5. Isolation of DNA and preparation of 'cot' curve.
6. Digestion, digestion of plant DNA, its separation, properties, and electrophoretic and visualization by ethidium bromide.

7. Isolation of RNA and quantification by a spectrophotometric method.

8. Separation of plant RNA by agarose gel electrophoresis and visualization by EB staining.


10. A study on the isolation of plant cell using an in vitro system for cell viability and cell growth.

References:


Chromatin organization, histones, organization of DNA, molecular genetics of eukaryotes, nucleolus and ribosomal RNA, heterochromatin, karyotype analysis, evolution, specialized chromosomes, B-chromosomes and supernumerary molecules, structural and some pairing.

Structural and secondary organization, meiotic and chromosome, recombination and translocations, frequency and modes of production, of recombinations; linkage, allelism, and fitness of single-gene and multigene systems.

Gene Expression: genetics of protein synthesis, products, the regulatory systems of eukaryotes, identification of genes, nucleotide sequences of prokaryotes and eukaryotes, regulation of gene expression in prokaryotes and eukaryotes. Panoply of genes, molecular structure, replication, attenuation and determination.

Gene recombination and genetic mapping, recombination.


Prototaxophyta: Morphology, general account of fossil flora evolution, general account of fossil plants; Lycopsida, Sphenophyta, and Ginkgophyta. Special reference to Lepidodendron, Calamites, Pecoptera, Lepidophyta.


Dy. Prof. J. N. V. Singh

University of Rajasthan
UNIT IV

TAXONOMY AND DIVERSITY OF SEED PLANTS

Unit I
Introduction Gymnosperms, the vessel-less and fruitless seed plants varying in the structure of their sperms, 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 (Lyginopteridaceae, Medullosaceae, Caytoniaceae and Glossopteridaceae). General account of Cycadeoidales 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.

Unit III
Numerical Taxonomy - Principles, concepts, operational taxonomic units (OTU), data processing and taxonomic studies, taximetric 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 prepared 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, 5 of which are mandatory and 8 out of which 3 must be answered. The question No. 1 will carry 20 marks and will be of subjective type. The rest of the type of questions such as multiple choice, true/false, short answer, and fill in the blanks will be of objective type.
Respiration: Aerobic and anaerobic respiration, amphibolic nature of TCA cycle, pentose phosphate and Embden-Meyerhof pathway, oxidative phosphorylation, ATP synthesis, high energy compounds: their physiological effects. Fat metabolism: synthesis and breakdown, fatty acids, lipid biosynthesis and metabolism.

Secondary metabolites: structure and function of secondary metabolites with special reference to terpenoids, alkaloids and steroids.

Plant growth regulators: auxins, cytokinins, gibberellics, physiological effects and mode of action.

Gibberellics: chemical nature, biosynthesis, physiological effects and mode of action.

Cytokinins: chemical nature, biosynthesis, physiological effects and mode of action.

Auxin-like acid: chemical nature, biosynthesis, physiological effects and mode of action.

Physiology of flowering: photoperiodism and vernalization.

Suggested Reading:
2. Extraction of seed proteins depending upon the solubility.
3. Determination of successive changes in enzyme activity, in proteins and/or sensitivity of seeds.
4. Details of proteins using thin-layer chromatography, employing Seakem.
5. Preparation of protein binding colony (USA) and detection of specific activity by lipid electrophoresis. or Bradford method.
7. SDS-PAGE for the separation of proteins from the given plant materials and comparison of antigen profile by staining with Coomassie Brilliant Blue R-250 solution.
8. Separation of enzymes, peroxidases by native polyacrylamide gel electrophoresis.
9. Radioisotope methods in plant physiology, metamorphosis (GM counting and applications and principles involved).

Suggested Reading (1985 Edition):

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body specificity of monoclonal antibodies and their uses, antibody engineering, various types of vaccines, preliminary account of Biofilms, diseases, vectors and their potentials.

Unit-III

Plant Pathology


Plant disease management - Classical, biological, IPM systems, development of ergot, biocontrol of plant diseases. Preliminary account of application of biotechnology in plant pathology.

Unit-IV

Symptomology. Identification and control of following plant diseases:

- Cercospora (Cotton: 
  - Red spot
  - Leaf blast
  - Bacterial leaf spot
  - Brown spot
  - Pink spot
  - Anthracnose
  - Rust
  - Powdery mildew
  - Black spot
  - Bacterial leaf blight
  - Tobacco mosaic virus
  - Tobacco stunt virus
  - Tomato spotted wilt mosaic virus
  - Tomato yellow leaf mosaic virus
  - Phytophthora cinnamomi
  - Rice blast
  - Rice blast knot

Suggested Books:

<table>
<thead>
<tr>
<th>QNo.</th>
<th>Question</th>
<th>Time Allotted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Describe the amount of water lost by evaporation from the soil.</td>
<td>150</td>
</tr>
<tr>
<td>2</td>
<td>Explain the process of carbon dioxide absorption by plants.</td>
<td>150</td>
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<tr>
<td>3</td>
<td>Discuss the concept of photosynthesis in plants.</td>
<td>150</td>
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<tr>
<td>4</td>
<td>Analyze the role of chlorophyll in photosynthesis.</td>
<td>150</td>
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<tr>
<td>5</td>
<td>Evaluate the effect of light intensity on photosynthesis.</td>
<td>150</td>
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<tr>
<td>6</td>
<td>Compare the rate of photosynthesis under different conditions.</td>
<td>150</td>
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<tr>
<td>7</td>
<td>Investigate the impact of temperature on photosynthesis.</td>
<td>150</td>
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<tr>
<td>8</td>
<td>Study the influence of water availability on photosynthesis.</td>
<td>150</td>
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<tr>
<td>9</td>
<td>Evaluate the role of carbon dioxide concentration on photosynthesis.</td>
<td>150</td>
</tr>
<tr>
<td>10</td>
<td>Examine the effect of oxygen concentration on photosynthesis.</td>
<td>150</td>
</tr>
<tr>
<td>11</td>
<td>Analyze the process of photosynthesis in aquatic plants.</td>
<td>150</td>
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<tr>
<td>12</td>
<td>Evaluate the role of light type in photosynthesis.</td>
<td>150</td>
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<tr>
<td>13</td>
<td>Investigate the impact of light quality on photosynthesis.</td>
<td>150</td>
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<tr>
<td>14</td>
<td>Study the effect of plant density on photosynthesis.</td>
<td>150</td>
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<tr>
<td>15</td>
<td>Analyze the role of mineral nutrition in photosynthesis.</td>
<td>150</td>
</tr>
<tr>
<td>16</td>
<td>Evaluate the influence of temperature on photosynthesis.</td>
<td>150</td>
</tr>
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*Note: Each question is allotted 150 seconds.*
& 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, scommoderm 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.


Suggested Laboratory/Field Exercises

1. Study of living shoot apices by dissections using plants such as *Tabernaemontana, Albizia*

2. Study of cytobhistological 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 collection of pollen grains for microscopic examination (maize, grasses, *Cannabis sativa, Crotoloria, 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 embryonic development through examination of permanent, stained serial sections.
21. Field study of several types of flowers 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)
Paper VIII. PLANT ECOLOGY

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. Environment impact assessment, ecosystem restoration.
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 IV


Suggested Readings:


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Numerical Laboratory Exercises

1. To determine minimum size and number of quadrat required for reliable estimate of biomass in grasslands.
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 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 Winkler's method.
9. To estimate chlorophyll content in NO3 fertilized and unfertilized plants leaves.
10. To determine rate of carbon dioxide evolution from different types of soil using soda lime method.
Paper IX: Plant Resource Utilization and Conservation

Scheme of Examination

Max. Marks: 100

Each paper will have two sections, out of which a student has to attempt Section II, which will be compulsory. There will be a question No. 1 which will be compulsory. There will be a question No. 1 and every 20 marks and will be of short answer type of 1 mark each. Each of these questions will have multiple choice type, short answer type, and fill in the blanks type.

Unit-I

Plant biodiversity: Concepts, status in India, utilization and conservation.


World centres of primary diversity of domesticated plants. The Indo-Burmese centre, plant introductions and secondary centres.

Unit-II

Origin, evolution, botany, cultivation and uses of: (i) Food forage and fodder crops, (ii) fibre crops, (iii) medicinal and aromatic plants, and (iv) vegetable oil-yielding crops.

Unit-III

Important fire-wood and timber-yielding plants and non-wood forest products (NWFPs): such as bamboo, rattans, raw materials for paper making, gums, tannins, dyes, resins and fruits.

Green Revolution: Benefits and adverse consequences. Improvements for meeting world food demands.

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Unit-IV

Strategies for conservation—ex situ conservation: Important efflux and initiatives, protected areas in India—sativars, national parks, biosphere reserves, wetlands, mangroves and coral reefs, conservation of wild biodiversity.

Strategies for conservation—ex situ conservation: Principles to practices: botanical gardens, seed banks, cryobanks, gene banks, in situ repositories, general accounts of activities of various Survey of India (BSI), National Bureau of Plant Genetic Resources (NBPRG), Indian Council of Agricultural Research (ICAR), Council of Scientific and Industrial Research (CSIR), and the Department of Biotechnology (DBT) for conservation, non-formal conservation efforts.

References


Suggested Laboratory Exercises

The practical course is divided into three sections: (1) Laboratory work, (2) Field survey, and (3) Scientific visits.

Laboratory Work

1. Food Crops: Wheat, rice, maize, chickpea (Bengal gram), potato, tapioca, sweet potato, sugarcane, morphology, anatomy, and biochemical tests for stored food materials.

2. Forage/Fodder crops: Study of any five important crops of the locality (for example, fodder-wheat, bajra, sesame, devan, guar bean, gram, Ficus sp.)

3. Plant Fibres:
   - Textile fibres: cotton, jute, linen, sunn hemp, flax
   - Cordeage fibres: coir
   - Fibres for stuffing: silk cotton or kapok

Morphology, anatomy, (microscopic) study of whole fibres using appropriate staining procedures.

4. Medicinal and aromatic plants: Depending on the geographical location college/university selects five medicinal and aromatic plants each from a garden crop field (or from the wild only if they are abundantly available):
   - Papaver somniferum, Aegyptis, Catharanthus roseus, Adhatoda zeylanica (syn. V. indica), Atropa belladonna, Catha cola serpentina, Withania somnifera, Pseudopulmonaria officinalis (P. tetrata), Andrographis paniculata, Acorus calamus, Zingiber officinale, Foenum-graceum, Rosmarinus officinalis, Calendula officinalis, Pandanus odoratissimus.

Study of five or six barium specimens or other vital materials to become familiar with these resources.

5. Vegetable Oils: Mustard, groundnut, soybean, coconut, sunflower, castor, morphology, microscopic structure of the oil-yielding tissues, tests for oil and iodine number.

6. Guns, resins, tanaline, dyes: Perform simple tests for gums and resins. Prepare a water extract of selected plants like Acanthus, Terminalia, mangoes, tea, Cassia spp., saffron, and dyes (turmeric, Bixa orellana, Indigo, Butea monosperma, Emblica officinalis) and perform tests to understand their chemical nature.

7. [Signature]

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Firewood and timber yielding plants and NWFs:

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 part of the town or city should be carried out by the entire class, in batches. Individual students will select one area to study and locate the trees planted on a particular day. They will identify the trees, mention their size, canopy shape, blooming and fruiting period and their status (healthy, diseased, affected, mutilated, misused or dying) and report whether or not the conditions in which they are surviving are satisfactory. The individual reports will be combined to present a larger map of the area, which can be used as an ongoing monitoring tool by the next batch of students or by the local communities, NGOs or civic authorities. The purpose of exercise in item C above is to make the students aware of the kinds of trees and value in urban 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 wetland
- A mangrove
- National Bureau of Plant Genetic Resources, New Delhi-110012 or one of its field stations
- Headquarters 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 one major crop or crops
- A recognized botanical garden or a museum (such as those at the Forest Research Institute, Dehradun, National Botanical...
Institute, Lucknow, Tropical Botanical Garden and Research Institute, Trivandrum), 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

Schemes of Evaluation

Max. Marks: 100

Each paper will have 9 questions, out of which a student has to attempt 8 questions, including the question No. 1 which will be compulsory. The question No. 3 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-1

Biotechnology: Basic concepts, principles and scope.

Plant Cell and Tissue Culture: General introduction, history, scope, concepts of cellular differentiation, totipotency.

Organogenesis and adventitious embryogenesis: Fundamental aspects of morphogenesis: somatic embryogenesis and androgenesis, mechanism, techniques, and utility.

Unit-2

Somatic Hybrids: Protoplast isolation, fusion and culture, hybrid selection and regeneration, possibilities, achievements and limitations of protoplasts research.

Applications of plant tissue culture: Clonal propagation, artificial seed, production of hybrids and somaclones, production of secondary metabolites/natural products, cryopreservation and genplasm storage.

Recombinant DNA technology: Gene cloning principles and techniques, construction of prokaryotic/eukaryotic libraries; choice of vectors, DNA synthesis and sequencing, polymerase chain reaction (PCR) finger printing.

Unit-3


Supplementary Exercises

1. Differentiation of cell cultures
2. Induction of plants from protoplasts
3. Production of plants from gametophytes
4. Production of plants from microspores
5. Production of plants from embryos
6. Production of plants from various sources and their ability
7. Effect of physical (e.g., temperature) and chemical factors on plant growth
8. Denaturation of protoplasts
9. Preparation and use of protoplasts
10. Preparation of protoplasts from various sources

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Unit-III


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

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 pathogens (morphology, physiology, serology and pathogenicity).


Unit-III

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

Unit-IV

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

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


Paper XII (b): SEED SCIENCE & TECHNOLOGY –II

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.
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:


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 macroconsumer), Implications of urbanization: problems of air pollutants, drinking water supply, odds, waste disposal.

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

Desert Ecosystem: Desert: 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.
2. Study of trichomes of xerophytes (Zizyphus, Lantana, Calotropis, Aerua) growing in your locality.
3. Study spread of root system of a perennial species in the soil
4. 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) & Secondary Air Pollutants (Smog, Acid rain, ozone and peroxyacetyl nitrate in air), Effects of air pollutants on Buildings & Monuments, pollution control (particulates and gaseous pollutants), depletion, control strategies;

Water Pollution: Eutrophication- Process and Control; Oil Pollution, Thermal Pollution, Heavy metal Pollution, Treatment, Disposal & Recycling, Minimum National Standards

Solid & Hazardous waste management & collection, Shrinking waste streams: 3Rs (Reduce, Reuse, Recycle), Hazardous waste: Definition, disposal and management

Climate Issues: Greenhouse gases (CO₂, CH₄, NOₓ, CFCs: sources, trends and role) and consequence of greenhouse effects (CO₂ for Biodiversity erosion), Carbon footprints, Carbon Sensing technology in environmental studies, the future of planet earth.

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


Suggested Laboratory Exercises
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 \( \beta \)-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 and catalysis through transition state bonding, lysozyme as model enzyme for catalytic mechanism, regulation of enzyme activity; feedback 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, folic acid, vitamin B12, ascorbic acid, vitamin A and vitamin D.

Unit-III
Secondary Metabolites:
Carotenoids and lignins: Structure and synthesis.
Flavonoids: (pyrrolizidine and rotenoids) distribution, chemistry and function.
Tannins: distribution, synthesis, and function.
Flavonoids and water-soluble pigments: Synthesis and function.
Halipenicogens: Distribution, chemistry and function.

Unit-IV
Alkaloids: Pyrrole, pyrroolidine, pyridine, polyacetyl line, tropine and indole alkaloids—distribution, synthesis, and function.
Saponins and sapogenins: Sterols, steroids, steroid 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 3 questions. The question No. 1 will be compulsory.
pulmonary. 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. With a limit of 20 marks.

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-proteins, phospholipid signalling, role of cyclic nucleotides, calcium-calmodulin cascade, diversity of protein kinases and phosphatases, signal transduction mechanisms with special reference to: Gibberellin induced 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, freezing and heat stress and oxidative stress.

Unit III

Photobiology - Photoreceptors, Phytochromes: history, discovery, physiological properties, interaction between hormones, and phytochrome, role of different phytochromes in plant development and flowering, mechanism of phytochrome signal transduction. Physiology 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 chromatography, 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 (e): Advanced Morphology and Morphogenesis

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
Embryosat-Basic types, and their interaction relationships, structural aspects of embryosat development: endosperm—interaction of the major types of endosperms, morphology and role of embryo development, Embryo—Major types, embryonic laws, comparison of Sounges and Johansen's system; physiological factors controlling growth and differentiation of embryo.

Unit-IV
Apolixis—genogenesis, androgeneisis, agricultural importance. Embryological features of the following families: Santalaceae, Anacardiaceae, Podostemaceae, Cucurbitaceae, Scrophulariaceae, Lamiaceae, Orobanchaceae, Lentibulariaceae.

Appendix (e): Advanced Morphology and Morphogenesis—II

Genes of Examination
Max. Marks: 100

Each paper will have questions, part of which a student has to answer. Questions will include the question block which will be compulsory. The question No. 1 will carry 20 marks and will be of several objective type of questions such as: multiple-choice type, one answer type, one word type and fill-in-the-blanks type. Unit-I

Development and morphogenesis: shoot apex the apical cell.
meristem, the subcellular and biochemical structure of the meristem. The mechanism of primordium 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 genesis of somatic embryogenesis nutritional factors, hormonal factors and embryo 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-XI (i) : Biosystematics of Angiosperms-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, true-false-answer-type, one-word-answer-type and fill-in-the-blanks-type with a limit of 20 words.
Unit-I


Unit-II

Botanical gardens and Arboreta, Information from plant geography, Indian plant geographical regions, Role of Herbaria in taxonomy, Taxonomic literature, Taxonomic resource information (Data analysis coding of characters, statistics).

Principles, rules, rank of plant nomenclature, ICBN, Principles and important rules, type method, Principle of priority, and its limitation, Name of hybrids and cultivars, Concept of Biocode.

Unit-III


Unit-IV


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-line answer type, one-word type and fill-in-the-blanks type, with a limit of 20 words.

Unit-I

Experimental taxonomy—Scope and Significance, Experimental categories. Relationship in experimental and orthodox taxonomy, Synthetic theory of evolution.

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 (qi): 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. I which will be compulsory. The question No. I 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 Haberland 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 auxiliary 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 references 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.

Dy. Registrar
(Academic)
University of Rajasthan
JALOR.
Paper-XII (q) : 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

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<tr>
<th>Q.No.</th>
<th>Questions</th>
<th>Marks allotted</th>
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<tr>
<td>1.</td>
<td>(a) Study the diseased plant material ‘A’ provided; make histopathological investigations.</td>
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**Syllabus : M.Sc. Botany • 57**

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**

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<tr>
<th>Time : 4 hours</th>
<th>M.M. : 100</th>
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<tr>
<td>Q.No.</td>
<td>Questions</td>
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<tr>
<td>1.</td>
<td>Study the morphological and anatomical features of given seeds.</td>
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<td>2.</td>
<td>Study the seed-borne mycoflora of given seed sample.</td>
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<td>3.</td>
<td>Determine the location of pathogen in different components of given symptomatic seeds.</td>
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<td>or</td>
<td>Estimate the spore load in given seed sample.</td>
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<td>4.</td>
<td>Examine the viability of seed lot.</td>
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<tr>
<td>or</td>
<td>Study the transmission of pathogen in infected seedling.</td>
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