UNIVERSITY OF RAJASTHAN
JAIPUR

SYLLABUS

M.Sc. BOTANY

(ANNUAL SCHEME)

M.Sc. (Previous) Examination  2018
M.Sc. (Final) Examination     2019

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
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. Botany
Scheme of Examination

M.Sc. (Prev.)

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 voce and 15% are awarded in each examination). Each practical examination will be of two 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 several short objective type of questions with choices. There will be one answer type, one word type and fill in the blank type.

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 practical searches as follows:

(i) Practical for compulsory papers of 200 marks of 3 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 several short objective type of questions such as multiple choice type, one line answer type, one word type and fill in the blank type.

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

Paper-I : Cell and Molecular Biology of Plants

Scheme of Examination

Max. Marks : 100

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

By Registrar
(Academic)
University of Rajasthan

[Signature]
Techniques in cell biology: Immuno-techniques, in situ hybridization, to locate transcripts in cell types, FISH, GISH, confocal microscopy.

Suggested Readings:

See the following review articles:
- Annual Review of Plant Physiology and Molecular Biology.
- Current Advances in Plant Sciences.
- Trends in Plant Science.
- Nature Reviews: Molecular and Cell Biology.

Suggested Laboratory Exercises:
1. Isolation of mitochondria and the activity of its marker enzyme, succinate dehydrogenase (SDH).
2. Isolation of chloroplasts and SDS-PAGE profile of proteins to determine the two subunits of Rubisco.
3. Isolation of nuclei and identification of histones by SDS-PAGE.
4. Isolation of plant DNA and its quantitation by a spectrophotometric method.
5. Isolation of DNA and preparation of 'cot' curve.
independent assortment and crossing over, molecular mechanisms of recombinant DNA, role of RNA and RecBCD enzymes in specific recombinases. Linkage map vs. physical maps, construction of genetic maps, correlation of genetic and physical maps, somatic cell genetics, alternative approach to gene mapping.

Unit-III
CYTOGENETICS
Mitosis: Spontaneous and induced micronucleus test, chromosomal aberrations, molecular basis of genetic instability, elements in prokaryotes and eukaryotes, mutagens induced by transposons, method of meiosis, DNA damage and repair, mechanisms of cancer and cancer chemotherapy, chromosomal aberrations in cancer and cancer chemotherapy.
Genetics: Chromosomes and inheritance, sex-linked inheritance.
Genetics of autosomes and sex chromosomes. Effect of alien species on phenotype in plants, crosses and back crossing, their use in breeding. Special techniques in plant breeding, reciprocal hybrids, complex breeding, genetic variance, cytoplasmic inheritance, Robertsonian translocations, translocations.

Unit-IV
Molecular cytogenetics: Nuclear DNA, chromosomes, restriction enzymes, DNA replication, DNA replication, chromosomes, physical and chemical methods of preparing chromosomes, cytogenetics, flow cytometry, microspectrophotometry, microspectrophotometry, high resolution microscopy in plant genetics.

Allen gene transfer through chromosomes, in plant breeding.
Transfer of whole genomes: examples from wheat, rice, barley, and other cereals. Genetics of alien chromosomes and chromosome segment, methods for detecting translocation between chromosomes, Hardy-Weinberg equilibrium, linkage and hybrid vigor in tetraploid plants, genetic basis of inbreeding and heterosis, exploitation of hybrid vigour.

Dy. Registrar
(Academic)

University of Agricultural
Nuristan
Suggested Readings

Suggested Laboratory Exercises
1. Linear differentiation of chromosomes through banding techniques, such as G-banding, Q-banding, and R-banding.
2. Silver banding for the study of a particular region, the 18S and 28S rDNA are transcribed.
4. Characteristics of behaviors of B chromosomes using maize or any other appropriate material.
5. Working out the effect of mono- and tri-aeny on plant pheno-
type, fertility and meiotic behaviour.
6. Induction of polyploidy using colchicine; different methods of the application of colchicine.
7. Effect of induced and spontaneous polyploidy on plant phenotype, metabolism, pollen and seed fertility and fruit set.
8. Effect of translocation heterozygosity on plant phenotype, chromosome pairing and chromosome disjunction and pollen and seed fertility.
10. Isolation of chlorophyll mutants, following irradiation and treatment with chemical mutagens.
11. Estimation of nuclear DNA content through microdensitometry and flow cytometry.
12. Fractionation and estimation of repetitive and unique DNA sequences in nuclear DNA.

Suggested Reading:

3. Paper III: Biology and Diversity of Lower Plants I
   Cryptomonas

Syllabus : AGG 310

Each paper will have 9 questions, out of which a student has to attempt 3 questions including the question No.1 which will be compulsory. The question No.1 will carry 60 marks and will be of short type of questions such as multiple choice, true/false, etc., and carry one mark each. The remaining 3 questions will carry 20 marks each.

Biology: Algae in diversified habitats (terrestrial, freshwater, marine), thallus organization, cell ultrastructure, reproduction, vegetative, asexual, sexual) criteria for classification of algae, pigments, reserve food, flagella, classification, salient features of diatomophyta, chlorophyta, chroophyta, xanthophyta, bacillariophyta, pheophyta and rhodophyta; with special reference to Microcystis, nostoc, chlorella, daphnia, euglenz, coenocyte, algal bloom, algal biofertilizers, algal as food, feed and use in industry.
TAXONOMY AND DIVERSITY OF SEED PLANTS

Unit I


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


Solbrig, O.T. and Solbrig, D.J. 1979. Population Biology and Evolution, Addison-Wesley Publiccating Co. Ind., USA.


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.
Microbiology and Plant Pathology

Unit I

Microbiology

1. Important landmarks in the history of microbiology
   a. Contribution of bacteria: General account, structure, function, and classification
   b. Viruses and viroids: structure and biological significance

2. Bacteria: morphology, characteristics, and structure
   a. Classification: division of bacteria, chemical analysis, replication, reproduction, and significance
   b. Cyanobacteria, photosynthesis, and importance

Unit II

1. Economic importance of microorganisms in agriculture, industry, and public health
   a. Yeasts and moulds: characteristics and role in causing pathological processes

2. Genetics of microorganisms: principles of genetic diversity and evolution

3. Immunity, allergy, and immunological aspects
   a. Immune response, antibodies, and antigenic determinants
   b. Molecular basis of immunity, antibody structure and function, affinity and antigen-
body specificity. Monoclonal antibodies and their uses, antibody engineering, cloning, types of vaccines: Preliminary account of Biofilms, biosensors, bioactuators and bioreactors.

Unit-III

Plant Pathology


Plant disease management: Chemical, biological, DVM system development, transgenesis, biopesticides; plant disease clinics. Preliminary account of application of biotechnology in plant pathology.

Unit-IV

Symptomology, identification and control of following plant diseases:

- Cereal diseases: Wheat (Rust, Smut, Bunt), Barley (Green rust, ergot and smut), Oat (Bolt).
- Pulse (Pea, Chickpea, Lentil, Gram): Cotton (Wilt), Grapes (Downy mildew and powdery mildew).
- Bacterial diseases: Wheat (Tund), Citrus scab.
- Viral diseases: Tobacco mosaic, Bathi yellow mosaic.
- Phytoplasma diseases: Little leaf ofBrinjal.
- Nematode disease: Root-knot of vegetables.

Suggested Readings

<table>
<thead>
<tr>
<th>Section</th>
<th>Question</th>
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</thead>
<tbody>
<tr>
<td>11</td>
<td>Define the term &quot;cytolysis&quot;.</td>
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<tr>
<td>12</td>
<td>What is the difference between cytolysis and autolysis?</td>
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<tr>
<td>13</td>
<td>How do bacterial lysis occur?</td>
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<tr>
<td>14</td>
<td>Describe the process of lysis.</td>
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<tr>
<td>15</td>
<td>Explain the role of enzymes in lysis.</td>
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**Reference:**

- [Lysis in Bacteria](https://www.tandfonline.com/doi/abs/10.1080/0023873X.2017.1326460)
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.


Suggested Laboratory/Field Exercises
1. Study of living shoot apices by dissections using plants such as *Tobernaemontana, Albizia*
2. Study of cytostatological 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 (*Launaeo, 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.
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 embryo sac 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)
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

Biodiversity: Major biomes of the world and impact of climate change on biodiversity. Balanced ecosystems, role of ecosystem services, ecosystem function and integrity assessment (local, national and global), species richness, extinction, Biodiversity Act of India and related international conventions, diversity indices, IUCN categories of threat, Hotspots.

Unit IV

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


Suggested Readings


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(Academic)
University of Rajasthan
JAIPUR
Suggested 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 azide modification of Winkler's method.

9. To estimate chlorophyll content in NO3-fumigated and unfumigated plant leaves.

10. To estimate rate of carbon dioxide evolution from different soil using soda lime or all ab absorption method.

11. To study environmental impact of a given development activity using checklist.

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JAIPUR
Paper IX: Plant Resource Utilization and Conservation

Scheme of Examination

Max. Marks: 100

Each paper will have 9 questions, out of which a student has to attempt 3 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

Unit 1

- Plant biodiversity: Concepts, status in India, utilization and concerns.

- Sustainable development: Basic concepts, origins of agriculture.

- World centres of primary diversity of domesticated plants:
  - The Indo-Burman centre, plant introduction 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.
  - (iv) vegetable oil-yielding crops.

Unit III

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

- Green Revolution: Benefits and adverse consequences, innovations for meeting world food demands.

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Unit IV
Strategies for conservation— In situ conservation: International efforts and India initiatives, protected areas in India— sanctuary, national parks, biosphere reserves, wetlands, mangroves and coral reefs, conservation of wild biodiversity.

Strategies for conservation—ex situ conservation: Principles— genebanks, botanical gardens, seed genebanks, field genebanks, cryobanks, cryopreservations, general account of the activities of National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Council of Scientific and Industrial Research (CSIR), and the Department of Biotechnology (DBT) for conservation of non-living genetic resources.

Suggested Reading
Suggested laboratory Exercises

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

Laboratory Work

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

2. Forage (forage crops): Study of any five important crops of the locality (for example, fodder sorghum, bajra, berseem, clover, guar, bean, gram, Ficus sp.)

3. Plant fibres:
   (a) Textile fibres: cotton, jute, linen, hemp, cannabis
   (b) Cordage fibres: coir
   (c) Fibres for stuffing: silk, cotton, kapok

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

4. Medicinal and aromatic plants: Depending on the geographical location, college/university select five medicinal and aromatic plants each from a garden crop field (or from the wild only if they are abundantly available).


   Study of five or better specimens or other visual 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. Gums, resins, tannins, dyes: Perform simple tests for gums and resins. Prepare a water extract of vegetable tannins (Bacca, Terminalia, mangroves, tea, Cassia spp., Myrobalans) and dyes (tumeric, Ruta ocellata, indigo, Betel moluccans, Lawsonia inermis) and perform tests to understand their chemical nature.
Survey
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 a part of the town or city should be carried out by the entire class, in batches. Individual students will select one avenue/road and locate the trees planted on a graph paper. They will identify the trees mentioning their size, canopy shape, blooming and fruiting period and their status (healthy, diseased, infected, mutilated, missed or dying) and report whether or not the conditions in which they are surviving are satisfactory. The individual reports will be combined to prepare a large map of the area, which can be used for subsequent monitoring either by the next batch of students, teachers, local communities/NGOs or civic authorities. The purpose of the exercise is to make the students aware of the kinds of trees and value in urban ecosystems and ecological services.
Scientific Visits:
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
- 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 one major crop or crops
- A recognised botanical garden or a museum (such as those at the Forest Research Institute, Dehradun; National Botanical...
Institute, Lucknow, Tropical Botanical Garden and Research Institute, Thiruvananthapuram, 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 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 short answer type. Type of questions include: multiple choice type, true and false type, one word type and fill in the blanks type.

Unit-I

Biotechnology: Basic concepts, principles and scope.

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

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

Unit-II

Somatic Hybridization: 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 somanones, production of secondary metabolites/natural products, cryopreservation and germlasm storage.

Recombinant DNA technology: Gene cloning principles and techniques, construction of gene libraries, choice of vectors, DNA synthesis and sequencing, polymerase chain reaction, DNA fingerprinting.

Unit-III

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

By, Registrar
Academic
University of Rajasthan
Jaipur
right, possible ecological risk and effect system.

Microbial genetics, molecular biology, transformation, selection of recombinants and transformation, genetic improvement of industrial microbes and nitrogen fixing bacteria technology.

Genetics and proteomics: Genomic and physical mapping of genes, molecular markers for introgression, disease resistance, artificial selection, high throughput sequencing genome projects, agricultural, functional genomics, proteomics, genomics, genome profiling and significance.

Efficient compounds in food and pharmaceuticals, production and applications.

References:
7. Epplen, J.N. and Company, New York, USA.
1. Growth characteristics of E. coli in different media and conditions.

2. Isolation of plasmid from E. coli by chloroform extraction and its quantitation spectrophotometrically.

3. Restriction digestion of the plasmid and estimation of the size of various DNA fragments.

4. Cleavage of DNA fragment in a plasmid vector in the host of the host bacterial population through restriction enzymes.

5. Replication of DNA sequence of the vector DNA by easy.

6. Isolation of protoplasts from various plant species and testing their vitality.

7. Effect of physical (e.g., temperature) and chemical (e.g., osmoticol) factors on protoplast viability.

8. Fusion of protoplasts following electroporation.

9. Organogenesis in somatic embryos on media with appropriate explants and preparation of artificial seed.

10. Demonstration of androgenesis in plants.

11. Electroporation of protoplasts and their transformation followed by regeneration of the reporter gene.
Co-cultivation of the plant mitocellular (plastic) with
Agrobacterium and from VCT cells was accomplished first


Scientific Publishers, Oxford, UK.

Black, Oxford.


Press, New Jersey, USA.


Hill, R.C. 2000. Plant Tissue Culture: Techniques and

Paper III (c) Advanced Plant Pathology

Each paper will have 9 questions, of which 5 students
must answer 4, 3 of which must be selected from a list
of questions, which will be available for 1 hour. The questions must be
completed in 1 hour, and will be
presented in an objective-type of question-answering,
with a limit of 90 minutes.

Dy. Registrar
(Academic)
University of Rhodesia

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-II
Bacteria: Classification and nomenclature of bacterial plant

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 phyllody, Spike disease of sugarcane.

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: 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:


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:

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 macro consumer), Implications of urbanization: problems of air pollutants, drinking water supply, floods, waste disposal.

Rural ecosystems: Rural environment and climate, physical complexes (fields, agricultural implements 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: 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, Aerva) 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
Paper XII (C): ENVIRONMENTAL BIOLOGY

Unit I

Air Pollution: Important Primary (CO, CO2, Oxides of Sulphur & Nitrogen, H2S, Chlorine, Particulates, Odour Producing compounds) & Secondary Air Pollutants (Smog, Acid rain, Primary Photochemical reaction, Formation of ozone and peroxyacetyl nitrate in air), Effects of air pollutants on Buildings & Monuments, plants, man and animals; Biomonitoring, Air pollution control (particulates and gaseous pollutants), Green belt, Ozone depletion, mechanism of 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, Minimum National Standards

Solid & Hazardous waste management & Resource Recovery: Solid wastes, Types, collection, Shrinking waste streams: 3Rs (Reduction, Recycle & Reuse), composting, energy from waste, demanufacturing; Methods of disposal: Land fill, Open dumps, Exporting waste; Hazardous waste: Definition, disposal and management

Unit III

Climate Issues: Greenhouse gases (CO2, CH4, N2O, CFCs: sources, trends and role) and consequence of greenhouse effects (CO2 fertilization, global warming, sea level rise, Biodiversity erosion), Carbon footprints, Carbon sequestration, Applications of GIS and Remote 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

\( 50 \)
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).
Proteins and Enzymes: Techniques of protein purification,

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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

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Unit-III

Secondary Metabolites:

Coumarins and lignins: Structure and synthesis.

Icetecides: (pyrethrins and rotenoids) distribution, chemistry and function.

Tannins: distribution synthesis and function.

Flavonoids and water-soluble pigments: Synthesis and function.

Hallucinogen: Distribution, chemistry and function.

Unit-IV

Alkaloids: Pyrrole, pyrrolidine, pyridine, polyacetyl linaline, tropine and indole alkaloids—their distribution, synthesis, and function.

Saponins and sapogenins: Sterols, steroids, steroidal alkaloids—their distribution, synthesis and function.

Cardiac glycosides: Their distribution, structure and function.
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 line answer type, one word type and fill-in-the-blanks type. With a limit of 20 words.

**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-Photorceptors, Phytochrome:* 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 (c): Advanced Morphology and Morphogenesis-I**

**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-
The question No. 1 will carry 20 marks and will be of several 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 II


Unit III

Anther-Organizational relationship of anther tissues; ultrastructure aspect of microsporogenesis: Pollen sporoderm pattern, pollen analysis, pollen fertility and sterility, allergy due to pollen. Pollen-pistil interaction, cytomorphology of style and stigma, role of pollen ultrastructural studies on pollen tube growth in the flower, chemotropism, fertilization. Viability, storage and germination of pollen.

Unit IV

Embryosac-Basin types and their inter-relationships, structural aspects of embryosac development. Endosperm—In relationship of the major types of endosperms, cytology and role in embryo development. Embryo-Major types, embryogenic laws; comparison of Souques and Johansen's system; physiological factors controlling growth and differentiation of embryo.

Unit V

Apomixis—genogenesis, androgenesis, agri-horticultural importance. Embryological features of the following families: Santalaceae, Lamiaceae, Podostemaceae, Cucurbitaceae, Scrophulariaceae, Acanthaceae, Orobanchaceae, Lentibulariaceae.

Paper XII (c): Advanced Morphology and Morphogenesis II

Examination Scheme

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. 1 will carry 20 marks and will be of several 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

Development and morphogenesis: shoot apex, the epidermal 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.

Morphogenetic factors: Physical, mechanical, chemical and genetic factors. molecular basis of morphogenesis in plants with special reference to work done in Arabidopsis.

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 (f) : Biosystematics of Angiosperms-I
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
Aims, components and principles of taxonomy. Alpha and Omega taxonomy, documentation, scope, significance and relationship of experimental and orthodox taxonomy, Evolutionary taxonomic classification.

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, I.C.N.—Principles and important rules, type method, Principle of priority, and its limitation, Name of hybrids and cultivars, Concept of Biocade.

Unit-III

Unit-IV

Paper-XII (f): Biosystematics of Angiosperms,II

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, open type 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 (g) : Biotechnology-1

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.

Propagations 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.
**Paper-XII (g) : Biotechnology-II**

**Scheme of Examination**

<table>
<thead>
<tr>
<th>Unit-I</th>
<th>Max. Marks : 100</th>
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</thead>
<tbody>
<tr>
<td>Transgenic plants—the concept and history of developments of transgenesis in plants.</td>
<td></td>
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<tr>
<td><em>Agrobacterium</em>-mediated transformation.</td>
<td></td>
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<tr>
<td><strong>Unit-II</strong></td>
<td></td>
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<tr>
<td>Direct DNA transfer into intact plants cells—microprojectile, bombardment and chemical uptake of DNA by plant protoplasts.</td>
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<tr>
<td>Tools for genetic transformation—Transformation vectors, promoters, terminators and markers and reporter genes.</td>
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<tr>
<td><strong>Unit-III</strong></td>
<td></td>
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<tr>
<td>Regulation of heterologous gene expression—factors affecting gene expression, introns, plants transcriptional factors, gene silencing, antisense RNA.</td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
<tr>
<td><strong>Unit-IV</strong></td>
<td></td>
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<tr>
<td>Manufacture of valuable products—antigens, antibodies, edible vaccines, enzymes, proteins.</td>
<td></td>
</tr>
<tr>
<td>Benefits and risks of producing transgenic plants—IPR and regulatory requirements, field testing and regulations to release transgenic plants in India.</td>
<td></td>
</tr>
</tbody>
</table>

**Skeleton Paper**

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

**Practical Examination**

<table>
<thead>
<tr>
<th>Time : 4 hours</th>
<th>M.M. : 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q.No.</td>
<td>Questions</td>
</tr>
<tr>
<td>1.</td>
<td>(a) Study the diseased plant material ‘A’ provided; make histopathological investigations.</td>
</tr>
</tbody>
</table>
Syllabus: M.Sc. Botany • 57

(a) 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

Q.No.  Questions  Marks allotted
1. Study the morphological and anatomical features of given seeds. 20

2. Study the seed-borne mycoflora of given seed sample 25

3. Determine the location of pathogen in different components of given symptomatic seeds. 10
   or
   Estimate the spore load in given seed sample.

4. Examine the viability of seed lot. 10
   or
   Study the transmission of pathogen in infected seedling.
or
Examine the seed disorder in given seed lot.
or
Examine the seed sample for physical purity

5. Spots 1-5 10
6. Viva-Voce 10
7. Practical Record 15

Skeleton Paper

M.Sc. (Final) Practical Examination
SPECIAL PAPER : ADVANCE ECOLOGY

Time : 4 hours M.M. : 100

1. Determine organic matter content of the given soil sample by
   Walkely & Black method. 25
   or
   Determine the dissolved O₂ in a given water body by Winkler
   iodometric method.

2. Prepare the glycerin mount of the given plant materials explaining
   their anatomical adaptations in relation to habitat. 25
   or
   Study the various types of trichomes and their rolling mecha-
   nism to withstand during drought of given plant material.

3. Determine the total hardness of the given water sample. 10

4. Determine pH of the given soil sample by pH meter. 05
   or
   Determine the conductivity of the given soil sample

5. Comment upon the spots (1-5) 10
6. Practical Record 15
7. Viva-Voce 10

Skeleton Paper

M.Sc. (Final) Adv. Plant Physiology
Practical Examination

Time : 4 hours M.M. : 100

Q.No. Questions Marks allotted

1. (a) Perform the physiological exercise given to you
   and write the object, materials and methods,
theory, observations results and precautions. 25
(b) Write the details of the principle involved in 5
the given exercise

2. (a) Perform the physiological exercise given to you 25
and write the object, materials and methods,
theory, observations, results and precautions.
(b) Perform test(s) for secondary metabolite(s) in 5
the given material.

3. Comment upon Spots 1 & 2 15
4. Practical Record 10
5. Viva-Voce 15

Skeleton Paper
M.Sc. (Final) Special Paper Herbarium and Adv. Taxonomy
Practical Examination

Time : 4 hours M.M. : 100

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Questions</th>
<th>Marks allotted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Make a study of epidermal system of the material A, B and C from a taxonomic point of view and assign these to their respective types giving reason (any one). Or Study the seed-coat anatomy of material A, B and C by means of sections. Give labelled diagrams to bring out the features of systematic significance.</td>
<td>8</td>
</tr>
<tr>
<td>2.</td>
<td>Make Palynological study of One of the specimens A, B and C. Draw labelled sketches and give the N.P.C. formula.</td>
<td>10</td>
</tr>
<tr>
<td>3.</td>
<td>Study the anatomy of one of the materials A, B and C and mention characters of systematic importance. Or Study the floral anatomy by means of serial T.S., of One of the materials A, B and C. Make a labelled sketch.</td>
<td>10</td>
</tr>
<tr>
<td>4.</td>
<td>Write a taxonomic description of any one of the twigs. A, B and C on the Flora Indian pattern. Key out these to the level you can.</td>
<td>20</td>
</tr>
</tbody>
</table>

Dy. Registrar
(Academic)
University of Rajashtan
Jaipur
5. With the help of suitable preparation make detailed morphological studies of chromosomes in the given material. 06

6. Prepare a synonymy on the basis of herbarium sheets studied. Find out the basionym and mention the correct name with reasons. 07

7. Comment upto the spots 1-6 12

8. Viva-Voce 10

9. Record and Sessional Work 17

Skeleton Paper
M.Sc. (Final) Practical Examination

Time : 4 hours

1. Cut serial transverse sections of the wax embedded material provided and submit two well prepared slides. Write the procedure followed briefly. 13

2. Study the seed Coat and anatomy of the seed provided. Identify the seed and classify it according to Corner's/Martin's system. 20

3. Make an acetylated preparation of the pollen grains from the material and describe the pollen morphology and identify the pollen types. 12

4. Dissect out and mount at least two stages of the endosperm/embryo from the material provided, make suitable mounts and labelled diagrams. 10

5. Count the cells in the given suspension culture using haemocytometer.

or

Plate the cells from the suspension culture using cell plating technique.

or

Demonstrate the inoculation of the anthers explant on the culture medium. 10

6. Comment upon spots 1 to 5 10

7. Viva-Voce 10

8. Practical Record 15

Dy. Registrar
University of Rajasthan
Jaipur
M.Sc. (Final) Papers VII, VIII, IX & X
Practical Examination

M.M. : 200

FIRST DAY (4 HRS.)

VII-Plant Development & Reproduction
IX-Plant Resources Utilisation and Conservation

1. (a) Make suitable preparation of the given material. Draw labelled diagram, and study the anatomical features with special reference to its vascular structure. Discuss points of special interest.
   16
   (b) With the help of suitable preparation study the floral/seedcoat/epidermal/micro-sporangium wall structure of the material provided. Draw labelled diagram and comment upon its features.
   16

2. (a) Identify any two......materials from the given samples. Give economic importance with special reference to origin, cultivation, part used and processing, if any.
   16
   (b) Mark the highest yield producing areas in the map provided to you.
   15

3. Spots 1-4

   M.Sc. (Final) Papers VII, VIII, IX & X

   Practical Examination

   Time : 4 hours

   Second Day (4 Hrs.)

   X- Plant Ecology.

   XI- Biotechnology and Genetic Engineering of Plants & Microbes.

   4(a) Calculate the frequency/Density/Species Cover of the plant species in the plot allotted to you by Quadrat method and compare your results with Raunkier frequency diagram.
   16

   (b) To investigate the water content/air content/soil particles in given soil sample.

   or

   Investigate the pH/chloride content/oxygen content of water sample given to you.
   16

   5 (a) Perform biotechnological exercise given to you.
   16
   (b) Write details for the exercise given to you.
   15

   6. Spots 1 to 4

   7. Records/Sessionals/Project/Herbarium

   30

   7. Viva-Voce.

   20