University of Rajasthan
Jaipur
SYLLABUS
M.Sc. BOTANY
(Annual Scheme)
M.A./M.Sc. (Previous) Examination 2021
M.A./M.Sc. (Final) Examination 2022

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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.
There will be 8 questions. Out of which 5 must be attempted. All questions carry equal weightage. There will be 3 hours duration to complete the paper.

Each theory paper will be divided into two parts consisting of short notes and long answers. The question paper will be set in English. The structure of the question paper is as follows:

Paper-I: Cell and molecular Biology of Plants

Paper-II: Genetics

Paper-III: Bacteriology

Paper-IV: Botany

Paper-V: Food Science

Paper-VI: Microbiology

Scheme of Examination

Max. Marks: 100

The paper will have 8 questions, out of which 5 must be attempted. There will be 3 hours duration to complete the paper.
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The progress in cell biology and molecular techniques, in this field will be discussed in various lectures, including types of RNA, DNA, and protein synthesis.

References:

See the following references for additional reading:
2. Developmental Biology: From Molecules to Embryos.

Laboratory Setting Up:
1. Identification of antibodies and the activity of antigen-antibody complex formation.
2. Identification of monoclonal antibodies using ELISA technique.
3. Identification of mRNA by northern blotting and RNA gel blotting.
4. Identification of DNA by Southern blotting and DNA gel electrophoresis.
5. Identification of DNA by dot blotting and nucleic acid gel electrophoresis.
Characterisation and isolation of DNA, nucleolus and ribosomal RNA, heterochromatin and euchromatin, evolution, speciation, sex chromosomes and pseudoautosomal regions.

Structural and functional studies of telomeres and telomerase, centromeres and translocation, recombination and transduction, genomics and genomics, metagenomics, proteomics and转录组学, RNA interference, cell cycle regulation, model organisms, and mammalian systems.

Genome-wide association studies in plants and animals, epigenetics, intergenic regions and non-coding RNA, CRISPR-Cas9 and genome editing.

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, taxometric methods for study of population variation and similarity- coding, cluster analysis, cladistics. cladogram.


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

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

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


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.
(b) Prepare an artificial key of the given plant materials (A, B & C).
(c) Make a suitable preparation of material XY.

1. Special interest, if any:
2. Perform the physiology experiments as assigned to you. Describe the methodology and record your observations.
   Procedure N
   Results

3. (i) Perform the microbiological exercise given below. Describe the methodology and record your observations.
   (ii) Prepare a suitable slide of the given microbiological exercise. Describe the methodology and record your results.

Paper XII
Paper XIII
Paper XIV
Paper XV
Paper XVII
Paper XIX
Paper XX
Paper XXI
Paper XXII
Paper XXIII
Paper XXIV
Paper XXV
Paper XXVI
Paper XXVII
Paper XXVIII
Paper XXIX
Paper XXX
Paper XXXI

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& REPRODUCTIVE BIOLOGY

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

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

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

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

Unit III
Reproduction: Vegetative options and sexual reproduction, flower development, genetics of floral organ differentiation, homeotic mutants in Arabidopsis and Antirrhinum, sex determination.
Male gametophyte: Structure of anthers, microsporogenesis, role of tapetal, 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 *Tibenna montana*, *Albizia*
2. Study of cytoshistological 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 *Coccinio, Tradescan*, 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, Crotalaria, Tradescantia, Brassica, Petunia, Solanum melongena*, etc.)
17. Tests for pollen viability using stains and in vitro germination.
18. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.

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20. Study of ovules in cleared preparations, study of monosporic, bisporic and tetrasporic types of embryos; see development through examination of permanent, stained serial sections.
21. Demonstration of several types of flower with different pollination mechanisms.
22. Emasculating, bagging and hand pollination to study pollen germination.
23. Study of nuclear and cellular endosperm through dissections and staining.
24. Isolation of zygotic globular, heart-shaped, torpedo stage and mature embryos from suitable seeds.
25. Polyembryony in citrus, jamun (Syzygium cumini) etc. by dissections.
26. Biochemical estimation (qualitative and quantitative) of metabolites of seeds.

Suggested Readings. (For Laboratory Exercises)

Unit II

Vegetation development: Temporal changes (cyclic and non-cyclic), mechanism of ecological succession (relay floristic and initial floristic composition), succession models (facilitation, tolerance and inhibition models), Changes in ecosystem properties during succession, concept of climax.

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

Unit III

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

Energy: Sources, Fossil fuels, Nuclear fuel, Solar Energy, Fuel Cells, Biomass, Hydropower,
Wind Power, Geothermal, Tidal & Wave energy, Energy conservation

Suggested Readings

   Wiley, New York.
   Cambridge, U.S.A.
   Benjamin/Cummings Publication Company, California.
   University Press, Cambridge, U.K.
Wind Power, Geothermal, Tidal & Wave energy. Energy conservation

Suggested Readings:

   Springer-Verlag, New York.
   Cambridge, U.K.
   University of California Press, Berkeley.

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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 with respect to species richness, density, diversity, and community coefficient similarity indices.
3. To estimate NVD of the species in a grassland 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 determine the dissolved oxygen content in eutrophic and oligotrophic water samples by a modified modification of Winkler's method.
9. To determine chlorophyll content in NADP-fixing and non-fixing aquatic plants leaves.
10. To determine rate of carbon dioxide evolution from different aquatic sediments at different sites using a method...
Paper: IX Plant Resource Utilisation and Conservation
Scheme of Examination
Max. Marks: 10
Each question carries 10 marks, out of which 7 marks are for the attempt and 3 marks for the short answer or conclusion.
A. Unilateral
Bilateral 20 marks and will be of 2 types: Short objective type and short answer type
C. Multiple choice type

Unit-I

Plants Diversity: Concepts, places of India, utilisation and concern.
Sustainable development: Basic Concepts; Origins of agriculture.

World centres of primary diversity of domesticated plants
The Indo-Burma centre, four introduction and secondary centres

Unit-II

Origins, evolution, domestication, cultivation and uses of:
(i) Food crops and fodder crops
(ii) Oil crops
(iii) Medicinal and aromatic plants
(iv) Vegetable oil-yielding crops

Unit-III

Important firewood 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. Imports for meeting world food demands.
Plants used as avenue trees for shade, pollution control and aesthetics, Principles of conservation, existing conservation strategies and role of plants based on International Union for Conservation of Nature.

Unit IV

Selected Readings
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Suggested Laboratory Exercises

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

Laboratory Work

Food Crops: Wheat, rice, maize, chickpea (Bengal gram), potato, tapioca, sweet potato, elephant ginger, arrowroot, microbacterial tests for stored food materials.

Fruit fodder crops: Study of five important crops of the locality (for example: fodder sorghum, bajra, pearl millet, guar bean, grass, Ficus sp.)

Plant Fibres:

(a) Textile fibres: cotton, jute, linen, ramie hemp, jute sisal
(b) Cordage fibres: jute
(c) Fibres for stuffing: silk cocoon or kapok

Morphology, anatomy, histology: study of plant leaves using appropriate staining procedures.

Medicinal and aromatic plants: (i) Botanical and geographical location college/university select five medicinal and aromatic plants each from a garden or field and label only if they are abundantly available.


Study of five/ten herbum specimens or other dried materials, to become familiar with these resources.

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

Cotton, resins, tannins, dyes: Perform simple tests for cotton and resins. Prepare a waxy extract of vegetable matter, Tannins, Terebintha, mangoes, tea, Cassia maggie, and dyes (tumeric, BIO-Ceylon, Indigo, Brown, and organic dyes) and perform tests to understand the chemical nature.
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 listing their scientific and local names and their various uses with appropriate illustrations.

A survey of the plant and animals of a part of the town or city should be carried out by the students, in another, individuals or groups will take on one plant or animal that is easy to find and locate the best methods of coping with it. They should identify the types, position of their food, places where they are found and their status (healthy, diseased, killed, or evicted), and record their observations and conclusions in a notebook. The results of the survey should be published and distributed among the students and the teachers will discuss the results with the students. The students should be prepared to present their results to the next batch of students. The survey should be published in schools and the results should be presented to the school officials. The purpose of the exercise in term C above is to make the students aware of the value of trees and other plants and the need to conserve natural systems and ecological services.

The following students should be taken to one of the following:

- A protected area (biosphere reserve, national park, or a sanctuary)
- A forest
- A mangrove
- National Bureau of Plant Genetic Resources, New Delhi (2012)
- Head office of the Botanical Survey of India or one of its Regional Circles
- A CSIR Laboratory doing research on the study of plants and their utilization
- An ICAR Research Institute or a field station dealing with crops and agronomy
- A recognized botanical garden or a museum (such as the Vosti Research Institute, Dehradun, National Botanical

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Institute, Lucknow, Tropical Research Garden and Research Station, Trivandrum, which has collection of plant products.

Note: The students are expected to prepare a brief illustrated note 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 8 questions, out of which a student has to attempt 5 questions including the question No. 1 which will be compulsory. The question No. 1 will carry 20 marks and will be of several Short objective type questions such as multiple choice type, one line answer type, true/false type, and fill-in-the-blanks type.

UNIT-I

Biotechnology: Basic concepts, principles, and scope

Plants Cell and Tissue culture: General introduction, history, scope, concept of cellular differentiation, totipotency.

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

UNIT-II

Somatic hybridization: Protoplast isolation, fusion and culture, hybrid selection and regeneration, potentials, challenges, and limitations of protoplasts research.

Applications of plant tissue culture: Clonal propagation, artificial seed, production of hybrids and recombinants, production of secondary metabolite/natural products, cryopreservation and germplasm conservation.

Recombinant DNA technology: Gene cloning, principles and techniques, construction of prokaryotic DNA libraries; choice of vector, DNA synthesis and sequencing, polymerase chain reaction (PCR), fingerprinting.

UNIT-III

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Unit-I


Unit-II


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

Unit-III

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

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

Unit-IV

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

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

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

Scheme of Examination

Max. Marks: 100

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

Unit-I


Unit-II

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


Unit-III

Virus, viroid and phytoplasma disease: Symptomatology and transmission of viral diseases; Potato virus X & Y, Tomato ring virus, bunchy top of banana; viroids and important viroid diseases.

Phytoplasma: General account; Sesame phyllody, Spike disease of chilli.

Unit-IV

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

Control of plant parasitic nematodes. Nematode Disease: a disease of wheat & barley, ear cockle of wheat, root-knot
PAPER: (b) SEED SCIENCE & TECHNOLOGY-I

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.

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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:


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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, 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, 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.

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5. Seed Viability by T.T.C. method
6. Dormancy in seeds
7. Soil moisture and temperature at different depths
8. Salinity of soil sample.
9. Study of Canopy and Basal Cover of trees in your study area
10. Estimate primary productivity of a water body by light and dark bottle method
11. Mean leaf area of 2 plant Species growing in your area by graph method
12. Relative humidity by hair hygrometer
13. Light intensity by lux meter
Air Pollution: Important Primary (CO, CO₂, Particulates, Odour Producing compounds), Primary Photochemical reaction, Formation of air pollutants on Buildings & Monuments, pollution control (particulates and gaseous pollutants, depletion, control strategies);

Water Pollution: Eutrophication- Process and metal Pollution, Treatment, Disposal & Recycling, Minimum National Standards

Solid & Hazardous waste management & collection, Shrinking waste streams: 3Rs (Reduce from waste, demanufacturing; Methods of disposal); Hazardous waste: Definition, disposal and management

Climate Issues: Greenhouse gases (CO₂, CH₄, consequence of greenhouse effects (CO₂ for Biodiversity erosion), Carbon footprints, Carbon Sensing technology in environmental studies, their

Unit I

Oxides of Sulphur & Nitrogen, H₂S, Chlorine & Secondary Air Pollutants (Smog, Acid rain, ozone and peroxyacetyl nitrate in air), Effects of plants, man and animals; Biomonitoring, Air pollutants, Green belt, Ozone depletion, mechanism

Unit II

Control; Oil Pollution, Thermal Pollution, Heavy Filling of Wastewaters, drinking water standards

Resource Recovery: Solid wastes, Types, action, Recycle & Reuse, composting, energy disposal: Land fill, Open dumps, Exporting waste; cement

Unit III

N₂O, CFCs: sources, trends and role) and Utilization, global warming, sea level rise, sequestration, Applications of GIS and Remote 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

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

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

Vitamins: Water and fat-soluble vitamins, biochemical function of thiamine, riboflavin, nicotinic acid, pantothenic acid, pyridoxin, folic acid, vitamin B$_{12}$, ascorbic acid, vitamin A and Vitamin D.

Unit III
Secondary Metabolites:
Coumarins and lignans: Structure and synthesis.
Steroids: (pyrroptins and steroids) distribution, chemistry and function.
Tannins: distribution, synthesis, and function.
Flavonoids and water-soluble pigments: Synthesis and function.

Haloxythenes: Distribution, chemistry and function.

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

Paper XII (d): Advanced Plant Physiology
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.
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.

Unit-I

Plant growth regulators: Natural and synthetic, biochemical and physiological effects of brassinosteroids, jasmonic acid, salicylic acid, polyamines, morphotropins 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

Phytochemistry: Phytochemical 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, entrainment (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-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 word type and filling in the blanks type. With a limit of 20 words.

Unit-I

Unit-II

Unit-III
Embryosac-Basic types and their interrelationships; structural aspects of embryosac development. Endosperm—In relation of the major types of endosperms, morphology and role in embryo development. Embryo—Major types, embryogenic laws, comparison of Soergel and Johansen's systems; physiological factors controlling growth and differentiation of embryo.

Unit-IV
Apomixis—Fenogogenesis, androgenesis, agricultrual importance. Embryological features of the following families: Santalaceae, Laricifloraeae, Podostemaceae, Cucurbitaceae, Scrophulariaceae, Umbelliferae, Orobancheaceae, Lentibulariaceae.

Paper-XII (e): Advanced Morphogenesis and Morphogenesis-II

Schemes of Examination
Max. Marks: 100

Each paper will have 8 questions, out of which a student has to attempt 4 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 answer type, one word type and filling in the blanks type, with a limit of 20 words.

Development and morphogenesis—Shoot apex the apical cell.
meristem, the subcellular and biochemical structure of the meristem. The mechanism of primordia initiation and 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**


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 (A): Biostatistics 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 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


Unit-II


Unit-III


Unit-IV


Paper-XII (ii): 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, one-time answer type, one-word type and fill-in the blanks type with a limit of 20 words.

Unit-I


Unit-II

Character—Character weighing. Characters variation, its role in speciation and isolation.

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

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


Suggested Readings:
Paper-XI (p) : Biotechnology-I

Scheme of Examination

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.

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


Unit-II


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 if fresh and dry weight culture density by cell count, packed cell volume mitotic index.

Microtechniques for plant cultures—fixation (FAA and gluteraldehyde) 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 (B) : Biotechnology-II

Scheme of Examination

Max. Marks : 100

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

Unit-I

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

Agrobacterium—mediated transformation.

Unit-II

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

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

Unit-III

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

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

Unit-IV

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

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

Skeleton Paper

M.Sc. (Final) Special Paper Adv. Plant Pathology Practical Examination

Time : 4 hours M.M. : 100

Q.No. Questions Marks allotted

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

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

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

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

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

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

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

7. Viva-Voce. 10

8. Spots (Four) 12

9. Practical record. 13

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. or Estimate the spore load in given seed sample. | 10
4. | Examine the viability of seed lot. or Study the transmission of pathogen in infected seedling. | 10

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Academy University