

M. Phil (Botany) Examination 2016

General : There will be four papers in all Paper I will be compulsory paper on basic research methodology and Instrumentation. Paper II and III will be selected by the candidate from any of the following groups. Paper I, II and III shall carry maximum 100 marks.

Group A :

Paper II Advanced topic in Plant tissue Culture and Biotechnology-I

Paper III Advanced topics in plant tissue Culture and Biotechnology-II

Group B :

Paper II Plant physiology-I

Paper III Plant Physiology-II

Group C :

Paper II Environment Biology- I

Paper III Environment Biology- II

Group D:

Paper II Phytopathology-I

Paper III Phytopathology -II

Group E:

Paper II Pollution Ecology-I

Paper III Pollution Ecology-II

Group F:

Paper II Topic in Advance Ecology and Environment Biology-I

Paper III Topic in Advance Ecology and Environment Biology-II

Group G :

Paper II Molecular biology and Microbiology-I

Paper III Molecular biology and Microbiology-II

Group H :

Paper II Bryology and Pteridology – Advanced Morphology.

Paper III Bryology and Pteridology – Recent Researches.

Paper IV Dissertation (related to paper II or III) shall carry 100 Marks.

Ordinance 123-V relating to scheme of M. Phil Examination

1. The M. Phil Course should be started/continued in a department when it has got at least three teachers who possess the qualification to supervise research towards the Ph.D. Degree.
2. The following minimum conditions should be ensured before permitting an affiliated college to start the M. Phil course:
 - (a) The college should have fulfilled all the conditions prescribed by the University for Affiliation for the post graduate course.
 - (b) The college must have been permanently affiliated with the University for running post-graduate course in the subject in which it intends to start the M. Phil course.
 - (c) There should be a staff of teachers out of whom at least three possess the qualification prescribed by the University to supervise research towards the Ph. D. Degree.
3. The general provisions of Statutes, Ordinance etc. in respect of admission of student to the examinations of the University including enrolment, discipline, Health & Residence as also for affiliation of colleges will apply for M. Phil Course/ Examination unless otherwise specified hereunder.
4. The Course of study for the M. Phil., degree shall extend over a period of one academic year. There shall be a continuous internal assessment as well as an external assessment. The examination for external assessment shall be written and/or practical as may be prescribed by the Board of Management on the recommendation of the Academic Council from time to time.
5. Every candidate shall be required to offer three written papers and one dissertation (equivalent to one paper) within this framework, each teaching department of the University shall recommend the course of study for the M. Phil, Examination its own subject(s) which shall be placed before the concerned Board of Studies, Faculty, Academic Council and the Board of Management for approval.
6. The number of candidates to be admitted to an M. Phil course in any department each year shall be decided by the department itself but it shall not be less than 5 and more than 15 in Arts/ Social Sciences, 10 in Commerce and 10 in Science. The actual number of students to be admitted in a session will depend on the availability of facilities in the Department concerned.
7. A candidate for admission to the courses of study for the degree of M. Phil, must have obtained a master's degree with atleast 55% marks in the post- graduate examination, a second division at the degree examination of the University/ or any other University/Institution recognized as equivalent there to, in to pursue the course.
8. In service candidates shall not be eligible for admission to the M. Phil. course. However, teachers may be allowed to join the course but only after taking leave from their employer for the duration of the course provided they fulfill the minimum eligibility conditions for the course.
9. The placement of every candidate under a Supervisor/guide shall be decided within two months from the date of admission.
10. Every candidate shall be required to attend a minimum of 66% of the lecturers, tutorial, seminars and practical (taken together) held in each paper. A certificate to this effect in respect of every candidate by the Head of the department/ Institution concerned to the Registrar so as to reach him at least 15 days before the commencement of examination.
11. Every candidate for admission to the examination shall submit the University an application in the prescribed form along with the prescribed examination and mark-sheet fee.
12. All paper-setters and examiners for the external assessment shall be external persons (i.e. those who are not working either in the university or in any of its affiliated colleges). The Board of Studies shall prepare a separate panel of examiners for M. Phil. The University Department teaching M. Phil, classes shall suggested a panel of examiners for each paper and dissertation for consideration of the Board of Studies. Appointment of paper setters and examiners shall be made by the examiner's

selection committees. If there is no representative from the University teachers on the department teaching M. Phil. for consultation with regard to appointment of paper-setters examiners for the M. Phil., examination in the subject concerned.

13. Unless otherwise specified, candidates' will have the option to answer their question papers and write their dissertation in English or Hindi as permissible at the post- graduate examination of the University in the same subject.
14. The M. Phil. Examinations will normally be held in the month of may each year and the last date of submission of dissertation will normally be 21 days prior to the commencement of the theory examinations. The internal assessment marks should be sent by various departments to the University office before the commencement of the theory papers. If the internal assessment marks of any candidate or from any department are not received before the commencement of the theory examination, marks in internal assessment in each paper be awarded to each candidate in proportion to the marks obtained by him in that particular paper in the external assessment.
15. The answer books and the dissertation of external examination shall be evaluated independently by two examiners and where the difference between the two awards exceeds 20% of the maximum marks allotted to the paper, the answer-book shall be evaluated by a third examiner. In the former case, the average of the two awards and in the later case, the average of the two nearest awards shall be taken into account.
16. Each theory paper shall consist of 100 marks. The dissertation shall also consists of 100 marks, it also be assessed by two external examiners. For a pass, a candidate shall be required to obtain:
 - (a) At least 40% marks in each paper separately.
 - (b) A minimum of 50% marks in the aggregate of all the papers prescribed for the examination. In the marks sheet successful candidates shall be classified as under.
 - (a) First division with distinction, candidates obtaining 75% or more marks in the aggregate.
 - (b) First division candidates obtaining 65% or more but less than 75% marks in the aggregate.
 - (c) Second division. All the rest.
17. Three periods of one hour each per week shall be provided for each theory paper and two periods for dissertation.
18. Omitted. The following minimum condition should be ensured before permitting an affiliated college to start M. Phil. Course:
 - (a) The college should have fulfilled all the conditions prescribed by the University for Affiliation for the post-graduate course.
 - (b) The college must have been permanently affiliated with the University for running post graduate course in the subject in which it intends to start the M. Phil. Course.
 - (c) There should be at least six-post-graduate teachers out of whom at least three should have already been recognized as Research Supervisors and possess at least ten years teaching experience of post graduate classes. The teachers should possess the minimum qualification prescribed by the University for the Post of Reader.
 - (d) There should be staff of 6 teachers out of whom at least three possess the qualification prescribed by the University to supervise research towards the Ph. D. Degree.
 - (e) The college will always maintain teaching staff for the M. Phil. Course as per University rules.
 - (f) The college should possess adequate reference books and research journals in the subject in which a college intends to start M. Phil. Course.

Paper I – Basic Research Methodology and Instrumentation

Time : 3 Hours

Max. Marks : 100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Microscopy – Light, Dark field, Phase contrast, Fluorescent, Transmission and scanning electron microscopy.
2. Photography – Micro. Macro. time lapse and video photography.
3. Molecular biological techniques – Southern. Northern and Western blotting. PCR. RELP and RAPD, Electrophoresis.
4. Chromatography – Paper. TLC. HPLC. GLC.
5. Histological, histochemical and cytological techniques.
6. Hcrbrium techniques and characteristic survey.
7. Plant tissue culture and Microbial culture techniques.
8. Colorimetry and spectrophotometer.

Group - A – Paper –II Advanced Topics In Plant Tissue Culture and Biotechnology - I

Time: 3 Hours

Max. Marks: 100

Note: - Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Cell and tissue culture media, initiation of aseptic culture, cellular totipotency, polarity, organogenesis and somatic embryogenesis.
2. Haploid production: Androgenesis (Anther and pollen culture, application in plant breeding).
3. In vitro cloning propagation (Micro propagation), techniques, merits and demerits. Automation in micro propagation.
4. Protoplast isolation, culture and fusion. Selection of hybridization and hybridization. Transfer of cytoplasmic male sterility using protoplast fusion methods.
5. Tissue culture as a source of genetic variability somaclonal and gametoclonal variations, selection, sources and causes of variations. Applications in crop improvement.

Group – A- Paper III – Advanced Topics in Plant Tissue Culture and Biotechnology – II

Time : 3 Hours

Max. Marks : 100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Genetic engineering : Techniques for the insertion of foreign genes into plant cells, transplasma and vector.
2. Transgenic plants Production, Role of transgenic plants in crop improvement, gene silencing, environmental considerations for release of transgenic plants.
3. Molecular biology of nitrogen fixation Nif and other genes involved in nitrogen fixation. Genetic manipulation of nitrogen fixation in legumes and non legumes.
4. Morphological, physiological and bio-chemical characteristics of microorganisms used in biotechnology, characteristics of microorganism used in biotechnology such as

Aspergillus, E.coli, Agrobacteriu Rhizobium Bacillhs, Saccharomyces. Spinllina, Streptomyces.

5. Plant cell culture for the production of useful chemicals pigments, flavours insecticides and other secondary products Isolation and characterization of mutant cell lines, auxotrophs, distant cell lines, herbicide resistance.

Group – B- Paper II – Plant Physiology– I

Time : 3 Hours

Max. Marks : 100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Water relations : cell water relations to classical and thennodynmic terms. stomatal physiology and concepts of stomata as physiological tool.
2. Stress Physiology: Plant Physiology in relation to heat low temperature, water, salt and chemical stress.
3. Bioenergetics : Enthoephy, entrophy, free energy, activation energy. Exo Endothermic reactions, Equilibrium constant, energy right bonds. Redox potential.
4. Electron Transport system : In relation to photosynthesis and Respiration
 - a. Photoelectron system in chloroplast.
 - b. Respiratory chain in mitochondria
 - c. Biochemistry of ATP synthesis.
5. Growth Physiology : Mechanism of action of plant growth regulators. Honnone sensitivity concept, Growth inhibitors, Role of PGR's in forestry. Horticulture and Agriculture, interaction of PGR's in relation to abscission and senescence.

Group – B- Paper III – Plant Physiology– II

Time : 3 Hours

Max. Marks : 100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Nitrogen metabolism : Nitrogen fixation, chemistry and synthesis of amino acids and proteins.
2. Carbon: Pathways C₃, C₄ and CAM and their significance.
3. Regulation of alkaloid :Introduction in plant tissue cultures. Introduction, biosynthesis, Enzymes involved in biosynthesis acuumuation, factors influencing the alkaloidal content (with special reference to Tropane and Indole alkaloids).
4. Steridal Sapogenins : Structure, biosynthesis and role of steroidal sapogenins with special reference to researches conducted in plant tissue culture.
5. Application of tissue culture :
 - a. In production of secondary metabolities (with special reference to hairy root culture and elicitation).
 - b. In Agriculture, forestry, horticulture pharmacological industries (General Account).
 - c. Soma-Clonal variations (General Account)

Group – C Paper II – Environmental Biology-I

Time : 3 Hours

Max. Marks : 100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Ecosystem management, biological diversity in desert ecosystem. Implimentation of ecosystem in the natural resource science, natural resources of Rajasthan, Lignite, Gypsum, Multani Mitti, Salt, Copper Mica and Zinc.
2. Concept of genecological differentiation and adaption, genetic model for range extension. Types of ecotypic variations.
3. Pollution hazards – Air, water, land and noise pollution, (causes and control) Green house effect. Global warning, CFC ozone depletion radiation and human diseases.
4. Pesticides and herbicides- Use and impact on Agroecosytem, salinization as a ecological problem and remedial measures.
5. Ecotechnology (Economical engineering) valuation of life supporting environmental systems, Concept of energy, rich plants, Desert plants yielding fuel, wax, gum, sazzi, Alchohal, Hydrocarbons.
6. Petroleum and allied products and alternative energy resources, Energy crises, causes and remedies.

Group – C- Paper III – Environmental Biology– II

Time : 3 Hours

Max. Marks : 100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Environmental conversation for development and restoration of degraded environment.
2. Besert management multidisciplinary approach, IGN and its impact on soil and vegetational development activities.
3. Screening of Desert Flora identification of fast growing taxa for biomass production, Red Data Book, Green Book, threatned plants of Rajasthan, Biosphere Reserves, Sancturies and National parks.
4. Changing crop patterns in Arid/Semiarid zones of Rajasthan. Its impact on human society, Desert ethnobotany, Waste land reclamations / Arable land as reserve.
5. Recent trends in linking the natural environment and economy ecological consequences of long term landscape. Transformation in relation to energy use and economic development.
6. Environmental awareness, perceptions and attitudes public participation. The socio-economic environment.
7. Allelopathy – General account with special reference to desert plants.

Group – D- Paper II – Phytopathology– I

Time : 3 Hours

Max. Marks : 100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Nature, Concept and importance of plant disease.
2. History of plant pathology, and its modern trends, plant pathology in India and role of plant pathology in Indian Agriculture.
3. Pathogenesis : Penetration and entry of plant pathogens and development of pathogenesis inside host tissues.
4. Epiphytotics : The spread of pathogens within crop areas. The factors which influence the dissemination of pathogens within crop ad areas and phyllosphere relation to seed pathology.
5. Disease forecasting and remote sensing.

6. Enzymes and toxins in plant disease.
7. Plant-Pathogen interaction at molecular and genetic level.
8. Plant disease control Physical, chemical, biological, quarantine. Plant disease resistance and breeding of resistant varieties, role of biotechnology with special reference to plant pathology.
9. Nutrition of plant pathogens : Growth methods of measurement, Kinetics analysis, synchronous growth rhythms, factors influencing growth.
10. Techniques of isolation., Purification of plant pathogens including biotrophic parasites culture testing efficacy of fungicides.
11. Disease appraisal and estimation of crop loss due to plant disease. Disease intensity and crop loss relationship, Mathematical expression.

Group – D- Paper III – Phytopathology– II

Time : 3 Hours

Max. Marks : 100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Classification of Plant diseases.
2. Symptomatology : Description of symptoms of fungal, bacterial and viral diseases, Identification of Plant diseases.
3. General account of diseases with special reference to symptoms casual organisms, disease cycles and control measures of the following diseases : Smuts-Loose smut of wheat, Covered smut of Barley, Whip smut of Sugarcane, Flag smut of Wheat, Bunt of Wheat; Rust-wheat rust, in seed rust; Wilt-Flax, Gram, Pigeon pea, Cotton Downy mildew-Maize, Bajra, Grapes and Opium popy; powdery Mildew of grapes, wheat and cucurbits, blast of rice *Helminthosporium* : *hosporum* early blight and late blight.
4. General account of bacterial diseases: Fire blight of store fruits, Tundu disease of wheat; Crown gall disease of gular, leaf spot of cotton. soft rot of vegetables, Bacterial blight of rice. Brown rot and ring rot of potato.
5. Classification, morphology, physiology and nature of viruses. Transmission of virus diseases, Disease cause by Mycoplasma, Virus diseases of potato caused by PVX and PVY. Mosaic disease of tomato and cucumber. Tobacco necrosis, Bunchy top of Banana. Yellow vein disease of Bhindi, Grassy shoot of sugarcane, Sessamum Phylloidy, spike of sandal, witches broom of legumes.
6. Anatomy and classification of plant parasitic nematodes. Disease caused by nematodes- Root Knot, Molya disease and ear cockle of wheat.
7. Classification and anatomy of insect induced gall. Physiology and biochemistry of insect galls formation. Study of some insect induced galls *Cordia*, *Ficus*, *Pongamia leaf gall*. *Zizyphus*, *Prosopis stem galls*.
8. Deficiency diseases: Khera disease of Paddy. Diseases due to nitrogen and boron deficiency. Air pollution induced foliar abnormalities in plants. Impact of air pollution on phylloplane microflora and disease development.

Group – E- Paper II – Pollution Ecology– I

Time : 3 Hours

Max. Marks : 100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer

any four question.

1. Global and regional environment issues : Environmental priorities in Indian with particular reference to Rajasthan.
2. Global warming : Causes – Carbon dioxide, methane, Chlorofluoro carbons and halogens, nitrous oxide; Deforestation consequences: Montreal protocol : Role of NGO's and consumers.
3. Acid Rain : Emission of sulphur dioxide and nitrous oxides. Transnational menace of acid rains, chemistry of acid rain ; Consequences and control.
4. Oil Pollution: Oil seepages, leakages tanker spills, fate of spilled oil: Physical and biological effects of oil pollution, control of oil pollution.
5. Desertification: Land degradation; Global programme of action stabilization of sand dunes.
6. Environmental policy postulates: taxes subsidies, incentive allowances, exemption from tax to capital gains, rebate of cess levied on consumption of – Zero discharge: Emission trading policies and rights.
7. Environmental economics GNP and ENP concepts.
8. Environmental politics, Concept of global environmental democracy:
9. Environmental and trade: the study state paradigm and free trade: GATT. TRIPS, TRIMS, patents: Trade Secrets, Copy right. Trade marks, Impact of trade on environment and vice-versa, Environmental dumping, pollution havens, hannonizations, Ecolabelling.
10. Poverty and environment: illiteracy; Poverty of resources, poverty in habitat, poverty indication.
11. Tourism and environment benefits of tourism, General effects on the environment benefits of tourism,. General effects on the environment.
12. War and environment conventional nuclear, chemical and biological Warfare's threat: Environmental security war and its alternatives, Bringing justice by force: Replacing the law of jungle.
13. Environmental education: Environmental attitudes, Environmental perception: Environmental ethics.

Group – E – Paper III – Pollution Ecology – II

Time: 3 hours

Max. Marks:100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Global and regional environmental hot – spots with particular reference to ecological imbalance. Environmental depadotio and socio-economic constraints.
2. Air pollution, Air equality – causes of pollution sources of pollution. Meteorological aspects of air Pollution, impact of air pollution on plants. Animals, man, environment, Indicator/susceptible species. Air pollution tolerance index. Control and abatement of air pollution.
3. Water pollution : Water quality, sources of water pollution. Impact of water pollution. Control and treatment of water pollution.
4. Noise pollution: Sources of noise, perception of noise. Audiogical, biological and behavioral effects of noise. Noise pollution control abatement.
5. Soil pollution: Sources and causes of soil pollution, subsequent ecological effects of soil-pollution.
6. Pesticide and heavy metal pollution: Sources, mechanism and effects of these substances increasing pollution in the environment. The concept of bioaccumulation and biomagnifications and examples of food chain poisoning. Ecological and economic effects of the pollutions.

7. Radioactive pollution: General idea about source and effects.
8. Environmental management: Legislation and awareness with reference to pollution problems, Environmental legislation significance and perspective. Impact of India's constitutional provisions, pollution control and environmental protection Acts Environmental awareness. Lessons from our ancient culture and heritage. Formal and informal education. Chipko movement past and present.
9. Environment monitoring and methodology : Monitoring of pollutants and pollution load. Sampling methods Analysis methods for air, water and soil pollution. Data collection systems analysis and methods in controlling and predicting the pollution problem.

Group – F – Paper II– Topics in Advance Ecology & Environmental Biology- I

Time: 3 hours

Max. Marks:100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Recent developments in eco system concept. Stability of ecosystem Homeostasis : Biodemographic and Biogeochemical regulation. Macarthur's Stability index, Ecosystem maturation, patterns of change in maturity.
2. System Ecology : Mathematical tools in model building. Ecosystem analysis and criteria for developing a system model. Ecological data analysis by use of computers with reference to Excel software.
3. Ecological variation and plant diversity. Environmental heterogeneity Plant response on environmental gradients. Genecological differentiation, evolutionary entities and species population analysis. Genetic model for range extensions.
4. Ecology of stress conditions : Florida and salts. Current researches oil inland salt marshes. Ecophysiological adaptation and production potential of plant under salt stress conditions. Traditional and potential utilization of halophytes.
5. Agro ecosystem: Pesticides as ecological problem. Bioremediation. Fertilization aspects in tropical agriculture. Fertilizer use in dry soils and salt affected soils. Fertilization and resistance to stress condition. Biofertilizers.
6. Stabilization of desert land use patterns in semi-arids. Screening of desert flora for identification of fast growing taxa. Threatened and fast depleting taxa of Rajasthan desert.

Group – F – Paper III– Topics in Advance Ecology & Environmental Biology- II

Time: 3 hours

Max. Marks:100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Plant invasion in the tropics with particular reference to Indian subcontinent. Strategies and effect of invaders colonising species and their recruitment. Alien plant invaders of tropical fresh waters their ecological consequences.
2. Ecological disturbances mining operations and its impact on vegetations. Renegotiation of disturbed lands. Nature of disturbances and population response. Species characteristics to disturbances. Reclamation of disturbed soils, suitable species for revegetation.

3. Researches on patterns of primary production and energy flow pathways in forest. forest depletion and their conservation. Bio-diversity and its relevance. Micropropagation and tissue culture in tree species.
4. Biomass production, bioenergy, biogas from waste water, Microbial degradation. Use of micro organisms in pollution control. Biomonitoring of waste toxins. Global energy crisis, alternative sources of energy.
5. Global climate changes : Air pollutions criteria and non criteria (conventional and unconventional) pollutions zone depletion, green house effect. Acid rains, Indoor pollution, effect of air pollution and modern control technologies.
6. Degradation of fresh "water bodies with special reference to Rajasthan. Eutrophication Biodynamic changes due to sawagwe waste disposal in water bodies. Haaazardous chemical flow of toxins. Minimizing toxic effects. Toxicity measurement and toxicity rating. Risk Assessment.

Group – G – Paper II– Molecular Biology & Microbiology- I

Time: 3 hours

Max. Marks:100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Genetic transfer process occurring in bacteria and bacteriophages conjugation, sexduction, transformation transduction.
2. The F Plasmids, functions encoded on F plasmids, interactions of the F1 plasmids with the bacterial genophore and their genetic analysis.
3. Repair and recombination of DNA constructs.
4. Gene splicing the production of artificial DNA constructs.
5. Effects of chemical and physical mutagens on chromosomes and nucleic acids.
6. Experimental mutagenesis in higher plants. Role of induced mutation in agriculture.

Group – G – Paper III– Molecular Biology & Microbiology- II

Time: 3 hours

Max. Marks:100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Practical use of bacterial generics Bacteria as degrades in synthesis of needed biochemicals. Bacteria as testing agents for carcinogens and mutagens. Bacterial utilization for production of noo-coventional energy.
2. Microbiology of food; micro-organisms important in food microbiology principle of foof preservation and spoil food and enzymes production by micro organisms.
3. Microbiology of water, Aquatic environment, water pollution due to microbes. Sewage disposal and potable water supplies.
4. Microbiology of soil; Decomposition of organic matter. carbon and nitrogen cycle, nitrogen fixation. interaction among soil micro organisms. Rhzobium and soil fertility interaction among soil micro-organism.
5. Principle of Immunology: Immunogloblins, antigens, antibodies, antigen antibody reaction methods, hypersensitivity.

Group – H – Paper II– Bryology & Pteridolgy : (Advance Morphology)

Time: 3 hours

Max.

Marks:100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Adaptations for land habit.
2. Distribution patterns of bryophytes and pteridophytes in India with special reference to Rajasthan geographic consideration.
3. Evolution and specialization of gametophyte and sporophytic generation.
4. Spore morphology, spore germination, gametophyte types in bryophyte and pteridophytes. Evolutionary tendencies in the sporophyte generation.

Group – H – Paper III– Bryology & Pteridology : (Recent Researches)

Time: 3 hours

Max. Marks:100

Note:- Eight questions will be set by the examiner. The candidate will be required to answer any four question.

1. Regeneration studies and perennation mechanisms.
2. Methods of propagation.
3. Ecology of bryophytes and pteridophytes.
4. Cytological studies in bryophytes and pteridophytes.
5. Recent research trends in bryophytes and pteridophytes.
6. Physiology, morphogenesis and culture of bryophytes and pteridophytes.