

MSc in Biology - final exam topics

Plant Biology Specialization

- 01:** Current topics questions in plant science I. Model plants, model systems in plant biology. Model plant cultivation in growth chambers. Artificial actinic illumination. Importance of hydroponic cultures. Soil cultures in cultivating plant material for experimental plant biology. (*Trends in plant science PR; Plant biology research project PR*)
- 02:** Current topics questions in plant science II. Research areas of plant ecophysiology. Environmental interactions of plants. Sampling and sample processing of environmental samples. (*Trends in plant science PR; Ecophysiology of drought L; Ecophysiology of tropical forests L; Plant-microbe interactions L; Plant biology research project PR; Physiology of fungi L*)
- 03:** Structure of plant and fungal cells. Biosynthesis, composition and physiological roles of the cell wall. Organelles and their physiological role. Vacuolization of the plant cell. Cell types in plant tissues. Callus cultures and their applications in plant biology. (*Molecular organography of plants L; Light and electron microscopy L; Physiology of fungi L; Plant-microbe interactions L; Ecophysiology of drought L*)
- 04:** Structure and function of plastids: structure of thylakoid membrane; changes in membrane organization as adaptation mechanism to environmental light. Methods to study the photosynthetic structures. (*Plant photobiology L; Light and electron microscopy L; Application of gel electrophoresis in plant biology PR*)
- 05:** Structure and function of the photosynthetic electron transport chain: harvesting the excitation energy and routes of non-photochemical quenching in the photosynthetic apparatus. Methods to measure the operation of the photosynthetic apparatus. (*Plant photobiology L; Plant biology research project PR*)
- 06:** Plant photoreceptor systems: function and interactions of phytochrome, cryptochrome, UVR8, phototropin, and Zeitlupe-FKF1-LKP1 systems. Redox signaling processes in chloroplasts. Light-regulated physiological processes in plants. (*Plant photobiology L*)
- 07:** Factors affecting the water uptake, transport and transpiration of plants. Morphological, physiological and lifespan adaptations in drought tolerance. (*Ecophysiology of drought L; Plant stress biology L; Plant biology research project PR; Application of gel electrophoresis in plant biology PR; Plant-microbe interactions L*)
- 08:** Structure and function of stomata. Appearance of stomata in the evolution of terrestrial plants. Physiology of stomatal movements, environmental factors influencing stomatal opening. Measurement techniques of transpiration intensity. (*Plant photobiology L; Ecophysiology of drought L; Plant stress biology L; Plant biology research project PR*)
- 09:** Organization of the nuclear and organellar genomes of plants: characteristics, taxon-specific differences (ploidy, gene density and repetitive elements, evolutionary and domestication effects). (*Plant molecular biology L; Molecular plant biology (laboratory project work) PR*)
- 10:** Molecular biology, and techniques in plant science. Sample collecting and sample processing for molecular biological analysis on a plant model. Techniques of genetic modification of plants. (*Molecular plant biology (laboratory project work) PR; Plant transformation and transgenic plants L*)

11: Characteristics of gene expression in plant. Transcription and translation. Gene expression assays: PCR-based methods and protein assays. (*Molecular plant biology (laboratory project work) PR; Plant molecular biology L; Application of gel electrophoresis in plant biology PR*)

12: Stress and photobiological regulation of gene expression in plants. Genetic background of microbial interactions. Plant signal transduction pathways. (*Molecular plant biology (laboratory project work) PR; Plant molecular biology L; Plant stress biology L; Plant photobiology L Plant-microbe interactions L*)

13: Effects of extreme temperatures on plants: damage, signal perception and transmission, defense reactions. Measurement techniques in the extent of the injury and the effectiveness of the defense. (*Plant stress biology L; Ecophysiology of drought L; Plant biology research project PR; Application of gel electrophoresis in plant biology PR*)

14: Effects of biotic stressors on plants. Disadvantage and damage caused by viruses, bacteria, fungi, animals and competing plants. Characteristics of the infection, herbivoria. Types and general forms of plant protection. (*Plant stress biology L; Bioactive ingredients of plants and fungi L; Plant-microbe interactions L; Physiology of fungi L; Plant biology research project PR*)

15: The effect of salt stress on plant life. Glycophyte and halophyte plants. Preventing the effects of salt stress at the cellular and individual levels, osmoregulation. Molecular mechanism of stress perception and stress response. (*Plant stress biology L; Ecophysiology of drought L*)

16: Effect of supraoptimal heavy metal concentration on plants. Heavy metals in the soil. Uptake, release and compartmentalization of heavy metals in the root. Physiological effects of heavy metal stress and stress protection. Measurement techniques of plant stress caused by heavy metals. (*Plant stress biology L; Plant biology research project PR*)

17: Effect of flooding on plants. Characteristics of oxygen deficiency, normoxia, hypoxia, anoxia. Flood perception and plant response to flooding. Mechanism of flood tolerance: aerenchyma, accessory roots, radial oxygen release. Measurement techniques in plant respiration. Plant strategies. (*Plant stress biology L; Plant biology research project PR*)

18: The concept of ionomics, field of application and the instruments applied in element analysis. Sampling methods and exploration. Analytical standardization, reference laboratories. Phenotyping, agronomic use. (*Plant ionomics L*)

19: Plant bioactive metabolites and analysis techniques. Universal and special metabolic products, their ecological, fungal and plant physiological, medical, industrial significance. (*Plant-microbe interactions L; Bioactive ingredients of plants and fungi L*)

20: Fungal bioactive metabolites and analysis techniques. Universal and special metabolic products, their ecological, fungal and plant physiological, medical, industrial significance. (*Physiology of fungi L; Plant-microbe interactions L; Bioactive ingredients of plants and fungi L*)

21: Plants as holobionts & the microbiome of plant I. Plant-microbe interactions, mutualistic symbioses, non-pathogenic interactions. Application aspects: plant protection, agriculture. Techniques of studying Plant-microbe interactions. (*Plant stress biology L; Bioactive ingredients of plants and fungi L; Plant-microbe interactions L; Physiology of fungi L; Plant biology research project PR*)

22: Plants as holobionts & the microbiome of plant II. Plant-microbe interactions, plant pathogenic microorganisms. Application aspects: plant protection, biocontrol. Techniques of studying interactions. (*Plant stress biology L; Plant and fungicides L; Plant-microbe interactions L; Physiology of fungi L; Plant biology research project PR*)

23: Microscopy techniques in studying plant structures. Sample preparation and processing for microscopy analysis. Eliminating artefacts. (*Light and electron microscopy I. L; Light and electron microscopy II. PR*)

24: Formation of the vegetative body of the plant sporophyte I: organogenesis of the root. Root initiation in the zygote, lateral root formation, formation of adventitious roots. The role of root morphology and architecture in plant stress biology (flood and drought stress). Root-microbial symbioses. (*Sexual plant reproduction L; Molecular organography of plants L; Plant-microbe interactions L Plant stress biology L; Ecophysiology of drought L*)

25: Formation of the vegetative body of the plant sporophyte II: shoot organogenesis. Shoot initiation in the zygote, the formation of lateral organs of the shoot. The effect of the environment on the development of shoot. The signaling role of light in shoot development. (*Sexual plant reproduction L; Molecular organography of plants L; Plant photobiology L; Ecophysiology of drought L*)

26: Reproductive biology of flowering plants I: formation of the reproductive shoot apex. Operation of the generative transformation, the role of environmental signals. Structure of flowers and molecular biological aspects of the development. Gametophyte life stage of flowering plants. (*Sexual plant reproduction L; Molecular organography of plants L; Plant photobiology L*)

27: Reproductive biology of flowering plants II: embryonic development in flowering plants. Ways of accumulating storage nutrients. Hormonal aspects of embryogenesis. Fruit formation of angiosperms. Seed development, dormancy, and signaling of the germination. (*Sexual plant reproduction L; Molecular organography of plants L; Plant photobiology L; Ecophysiology of drought L*)