Environmental Engineering MSc
State Exam Information

The system of knowledge assessment

a) thesis requirements and credits assigned to the thesis: 30 credits

b) conditions for taking the state exam
- successful completion of all the subjects from semesters 1 to 4 in the curriculum obtaining at least 120 credits,
- completion of the internship for full-time students (min. 4 weeks)
- thesis completion and submission

c) the state exam (oral exam)

The core material of the state exam (A) (responsible instructor):
- Environmental State Assessment, Auditing & Environmental Modelling and Environmental Informatics (Dr. János Támos)
- Environmental Operations (Dr. Lajos Gulyás)

Field-specific knowledge (B, based on the specialization):
- B1: Built Environment Specialization
- B2: Environmental Technology, Planning, Constructions Specialization

Thesis defense (**D**)

The state exam consists of three parts:

1. The core material of the state exam, which includes the assessment of environmental status and the technological introduction of their solutions.
2. Filed-specific knowledge, the topics of which are based on the specialization chosen by the student. These topics are built heavily on the workshops assigned to the MSc training program, providing the elaboration of realistic engineering tasks.
3. Thesis defense based on an oral exam

The state exam grade (SE) is calculated using the following formula:

$$SE = (A+B+D)/3$$

Environmental Engineering MSc
State Exam Topics

Core material (A) (responsible instructor):

1. Environmental State Assessment, Auditing & Environmental Modelling and Environmental Informatics (Dr. János Támos)
2. Environmental Operations (Dr. Lajos Gulyás)

A: Core material		
No.	**Title**	**Topic**
1.	Describe the classifications of remote sensing data sources, the main national and international data sources and their environmental applicability!	**Environmental State Assessment, Auditing**
2.	Describe the application of mobilGIS in the on-site survey and environmental impact assessment!	
3.	Describe the applicability of geostatistical calculations in the sampling strategy and environmental condition assessment.	
4.	Describe the GIS evaluation of site selection and resource exploration!	
5.	Describe the tasks and critical points of environmental auditing.	
6.	Evaluate the advantages and disadvantages of raster and vector GIS models.	**Environmental Modelling and Environmental Informatics**
7.	Describe the most common spatial operations and their application possibilities!	
8.	Describe the structure and application possibilities of vector (e.g. ESRI) and raster (e.g. IDRISI) software in environmental modeling!	
9.	Describe the sources of error and uncertainty and their treatment in environmental modeling.	
10.	What Digital Surface Models do you know and how do you use them in modeling (hydrological / noise / air pollution)?	
11.	Describe the advantages of the quality management system (ISO 9001) and the seven principles of quality management.	**Environmental and Quality Management**
12.	Describe the objectives of the environmental management system (ISO 14001) and the appearance of the PDCA-model within the standard.	
13.	Describe the importance of demand forecasting in production management. What types of forecasting models can be differentiated? Describe 3 forecasting methods, as well as show 2 indicators used in the calculation of forecast accuracy!	**Production Management and Life Cycle Analysis**
14.	What is the life cycle and what are the stages of the entire life cycle? What is the purpose of life cycle assessment? Which standards can be applied in life cycle assessment? Describe the process of life cycle assessment!	

15.	Risk and the process of risk assessment. Environmental Risk Assessment (ERA). Chemical, biological, and physical stressors. Receptors, exposure pathways.	**Safety and Environmental Risk**
16.	Describe and characterize transport processes in the environment and environmental protection: Measurement, units and dimensions. Extensive and intensive properties. The four extensive properties of environmental engineering. Characterize the flow rate and flux.	**Environmental Operations**
17.	Characterize the transport phenomena in environment and environmental engineering. Flow rate and driving force. Mechanism of transport processes. Convective stream (bulk flow); Conductive stream: Newton's law of viscosity, Fourier's law of heat conduction, Fick's law of diffusion. Interphase transport and transfer coefficient. Balance equations of environmental engineering.	
18.	Fluids in rest, Pascal's law. Fluids in motions: Types of flow, Reynolds number. Energy balance of flowing fluids, Bernoulli's equation. Laminar and turbulent flow in pipes. Basic equation of laminar flow. Pressure loss of flowing fluids. The friction coefficient as a function of Reynolds number.	
19.	Describe the flow around immersed object. Drag force, projected area, drag coefficient. The drag coefficient as a function of the Reynolds number. Sedimentation. Fluids and settling particles. Determination of the terminal settling velocity. Design of settlers.	
20.	Fluids flow through packed bed or porous media. Characteristics of packed bed: porosity of bed, specific surface area of particles. Friction coefficient of a packed bed as a function of Reynolds number. Pressure loss of packed bed, Ergun equation. Fluidization and filtration.	
21.	Describe the mechanisms of heat transport. Heat transition, overall heat transfer coefficient. Heat exchangers. Double pipe heat exchangers. Logarithmic mean temperature. Shell-and-tube heat exchangers. Evaporation. Type of evaporation equipment and methods of evaporation.	
22.	Describe the mass transfer operations. Methods of mass transfer operation. Gas-liquid process. Absorption. Choice of solvent for absorption. Phase equilibrium of gas-liquid system. Continuous contact operation. Limiting gas-liquid	

	ratio. Determine of high of transfer unit (HTU), number of transfer unit (NTU) and the high of tower.	
23.	Describe the distillation process. Applications of distillation. Relative volatility of vapor-liquid system. Batch- and continuous distillation. Basic distillation equipment and operation. Distillation column design. Reflux. Minimum reflux ratio and total reflux. McCabe-Thielle design method.	
24.	Describe the solvent extraction. Basic steps of solvent extraction. Single stage equilibrium extraction. Using mixer-settlers for extraction. Multistage cross-current extraction. Multistage counter-current extraction. Differential extraction.	
25.	Describe the process of adsorption. Properties of adsorbents. Adsorption isotherms. Batch adsorption. Packed bed adsorption. Breakthrough curve. Characteristics of chemical reactors in environment and environmental operations.	

Field-specific knowledge (B):
B2: Environmental Technology, Planning, Constructions

B: Field-specific knowledge based on the specialization Environmental Technology, Planning, Constructions		
No.	**Title**	**Topic**
1.	What is the definition of soil degradation? Describe both its causes and effects. Please, describe techniques by which soil degradation can be reduced or avoided. Mention examples for areas/countries where serious soil degradation/land degradation occurs!	**Environmental Technologies I (Soil Protection)**
2.	What is the main soil physical parameters? Give an example of how they can affect the hydraulic conductivity and water holding capacity of the soils?	
3.	Describe the soil erosion processes (physical: wind, water, gravitational) and the forms of soil erosion (splash, sheet, rill, gully erosion)! Describe some related soil erosion measurement techniques and practices. Please, describe a soil erosion model, e.g. RUSLE.	
4.	Classify the remediation methods of polluted soils. Describe the soil washing method!	
5.	Water resources, water utilization, water balance.	**Environmental Technologies II (Water Protection)**
6.	Vulnerability of water resources, global water balance and related issues.	
7.	Assessment, monitoring and protection of drinking water resources. Water Framework Directive of the European Union.	
8.	Methods for qualitative and quantitative protection of surface water bodies and subsurface water bodies.	
9.	Environmental risk assessment methodology, Legal relations of ERA and Tools of ERA.	
10.	Drought & Flood prevention, risk reduction and mitigation. Rehabilitation of contaminated water bodies.	
11.	Hydrogeological and transport processes and modelling. Regional sharing of water.	
12.	Stages of air pollution. Indicator air pollutants (O_3, SO_2, CO, NO_2, PM): physical and chemical properties, sources, residence times, health and environmental issues, standard measurements.	**Environmental Technologies III (Air and Noise Protection)**
13.	Smogs: types, occurrence, weather conditions, pollutants, health issues. Chemical processes of photochemical smog. Measures in case of smog alert. Vehicle-related emissions: air pollution of internal combustion engines, mitigation of emission by catalytic converters.	
14.	Definition of noise, Human auditory range, Frequency analysis, Sound propagation outdoors	
15.	Fundamentals and basic terminology of noise control, Noise measurements and Instrumentation	
16.	Describe the waste hierarchy! Explain what each stage means and how they can be implemented in practice.	**Environmental Technologies IV (Waste Recycling)**
17.	Describe the composting process (input and output materials)! What kind of waste types can be composted? What are the key parameters and their optimal ranges from an engineering point of view?	

18.	Describe the general technology (machines and separators) used in waste processing and recycling facilities to sort recyclables.	
19.	Describe the energy demands of the buildings.	**Recovery Systems of Renewable Energy Sources**
20.	Showcase the geothermal and geothermic utilization methods.	
21.	Showcase the solar energy harnessing methods	
22.	Showcase the application of biomass powered systems.	
23.	Describe the near natural and cleaner technology solutions, based on an agricultural example. Describe the benefits of it and make a comparison to other technology solutions based on environmental pollution.	**Near-natural and Cleaner Production Technologies**
24.	Describe the near natural and cleaner technology solutions, based on an industrial example. Describe the benefits of it and make a comparison to other technology solutions based on environmental pollution.	
25.	Role of management and management standards/systems in near natural and cleaner production (ISO 14 001, EMAS, ISO 26 000, ISO 50 001, Integrated Management Systems) and pollution prevention.	