



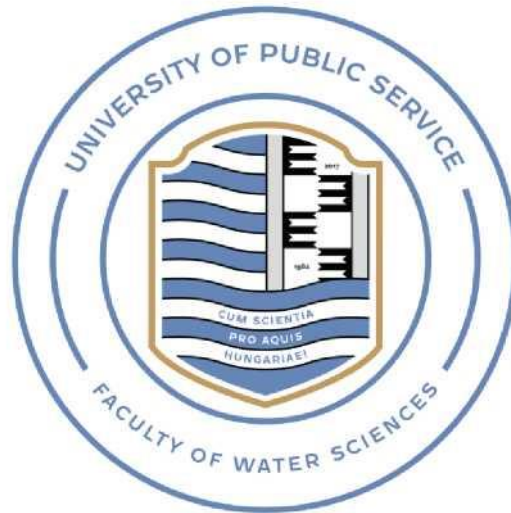
**NEMZETI  
KÖZSZOLGÁLATI  
EGYETEM**  
LUDOVIKA

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VÍZTUDOMÁNYI KAR

## **FINAL EXAM TOPICS**

### **ENVIRONMENTAL ENGINEER (BSc)**



**2023, BAJA**

## **ENVIRONMENTAL ENGINEER (BSc)**

# **PROTECTION OF ENVIRONMENTAL ELEMENTS AND ENVIRONMENTAL TECHNOLOGIES (A1)**

## ***For all specialization***

### **1. Environmental loads and their reduction**

- fundamental reasons
- effects and their extents, examples
- environmental elements to be protected
- definition and interpretation of ecosystem
- ecological restoration and nature conservation
- methods for averting harms

### **2. Aquatic environment and its properties**

- biotic and abiotic factors
- occurrence and importance of N and P compounds
- water contaminants and the mechanisms of their effects
- impact of pollutants on water utilization
- natural cleaning processes in surface waters

### **3. Water quality, quality assessment**

- assessment methods, general considerations
- water quality indicators: physical, chemical, hydrobiological parameters
- scope, application and methods of the Water Framework Directive
- classification according to the Water Framework Directive

### **4. Water quality databases**

- information demands
- design of sampling programs
- evaluation and processing of water quality data
- water quality databases

### **5. Acceptable loading of water bodies**

- Correlation between organic load and oxygen balance
- effects on biotopes and biocoenosis
- important correlations of the oxygen balance and its mathematical models
- type of limit values
- penalties and fines for wastewater discharge and environmental loads

### **6. Point and extensive water contaminations**

- main types of pollution
- aim and tools of water quality control
- protection by technological and other methods
- dilution, storage, re-routing, retention
- overview, evaluation and classification of technological and non-technological water quality control methods

**7. Treatment , utilization and disposal of liquid manure**

- quality and qauntity, environmental impact of liquid manure
- necessity of treatment, treatment methods
- disposal possibilities and limitations
- technological solutions and their common parameters

**8. Waste classification, waste managment frameworks**

- principles
- classification of wastes, qualitative and quantitative properties
- Sampling and evaluation, parameters to be analyzed
- Waste managment policies and strategies

**9. Collection and transport of solid municipal waste**

- requirements and tools of collection - pre-treatemnt - transport - storage - administration
- methods, aim, advantages and disadvantages of selective collection
- advantages and disadvantages of regional and decentralized waste treatment
- aim and layout of transfer stations

**10. Physical and chemical waste treatment and disposal**

- preparation, component separation, phase separation
- neutralization, coagulation, oxidation, reduction, hydrolisys, electrochemical processes, embedding, solidification

**11. Thermic waste treatment processes**

- classification, application possibilities and aims of thermic processes
- advantages and disadvantages of incinertaion plants, furnace types and furnace selection
- air pollution from waste incineration, reduction methods

**12. Aerobic organic waste treatment processes (composting)**

- aim, application, influencing factors, advantages and disadvantages of composting
- composting technologies
- required measurements and input parameters for the dimensioning of composting facilities, calculation steps
- aspects of design and operation

**13. Anaerobic organic waste treatment processes (anaerobic digestion)**

- aim, application fields, infulencing factors of anaerobic digestion
- advantages and disadvanatges of anaerobic digestion of wastes with high organic material content
- dry and wet digestion technologies
- required measurements and input parameters for the dimensioning of anaerobic digestion facilities, calculation steps
- aspects of design and operation

**14. Municipal landfills**

- Site selection, different types, and possible layouts of landfills
- design principles, protection technology, water management and treatment, biogas treatment and utilization
- recultivation of landfills

**15. Collection, transport, storage and disposal of hazardous waste**

- properties of hazardous waste
- requirements for collection, storage and transport
- possibilities for temporary and final disposal, operation of facilities

**16. Fundamental tasks in soil protection**

- demand for sustained soil fertility
- protection against erosion, deflation
- physical, chemical and biological soil improvement methods and tasks

**17. Irrigation with wastewater, soil as recipient**

- role of the soil in handling contaminations
- self-cleaning processes in the soil (physical, chemical, biological), role of the vegetation
- effect of the most common contaminations on the soil
- calculation of acceptable contaminant load of soils, dimensioning soil as recipient

**18. Contaminants in the soil and in the groundwater**

- transport and transformation of contaminant substances
- transport and modeling of the reactions
- typical transport processes
- methods to restrict contaminant transport

**19. Point-like contaminations and contamination elimination in soil and groundwater**

- contaminant sources, common contaminants
- exploration and localisation of the contamination
- evaluation based on allowed load, risk assessment, decision support
- applicable technologies, considerations for technology selection

**20. Subsurface oil contamination**

- properties of oil contaminations, investigation
- transport of oil in soil and groundwater
- damage assessment, planning of the elimination, in situ and ex situ methods for oil contaminations

**21. Air as an environmental element**

- composition and structure of the atmosphere
- the characteristics, physiological and other effects of the most common pollutants on the environment
- greenhouse effect
- pollutants and pollution sources and types
- the process of air pollution
- general rules of air protection

**22. Air monitoring**

- Air pollution agglomeration and zone
- Measurement Network: establishment, operation, structure
- Air quality index, Public information
- Air quality plan and its content requirements
- Short-term action plans and its content requirements

**23. Regulation of the emission of air pollutants**

- the process of air pollution
- the hungarian rules for point and diffuse sources: Establishment, notification, registration, data reporting and fee payment obligations,
- area of impact definition, significance
- modeling opportunity: grouping, characteristics

**24. Air cleaning technologies**

- Grouping of air cleaning methods and equipment
- Particulate separation:
  - Gravity separators
  - Cyclones
  - Electrostatic Precipitators
  - Dry and wet separators

**25. Air cleaning technologies**

- Separation of gases/vapours: Absorption and adsorption gas purification
- Sulfur dioxide emission reduction
- Nitrogen oxide emission reduction

**26. Environmental impact of noise and vibration**

- fundamental definitions, origin of sound and noise
- spreading of noise and vibration
- descriptive parameters, characteristic curves, impact on health, limit values and principles
- legislation regarding noise and vibration

**27. Noise reduction methods**

- active and passive methods
- soundproofing and their layout
- soundproofing of residential buildings, industrial facilities and individual machines
- reduction of traffic noise

**28. Environmental impact assessment**

- aim, licensing procedures
- the general content requirements of the environmental impact study
- the process of preparing an environmental impact study, environmental impact assessment methods

**29. Environmental monitoring systems**

- data and information demand of environmental monitoring, protocols and methods
- sampling of environmental elements
- parameters to be measured
- design of monitoring network and sampling interval
- data evaluation
- environmental databases

**30. Water management**

- Structure of water management
- Legislative aspects of water management
- Permits

**31. Water balance management**

- Elements of water balance
- Water bases
- Hydrological water balance diagrams
- Water storage - demand relation

**32. European Water Framework Directive**

- Aim, content and execution

## **WATER AND WASTEWATER TREATMENT SPECIALIZED STUDIES**

### ***For water and wastewater treatment specialization***

#### **1. Structure and design of drinking water distribution networks**

- functional parts of distribution networks
- systems with and without elevated tanks, regional distribution networks
- determination of water demands, demand variations over time and location, parameters of drinking water demand

#### **2. Subsurface water intake**

- types of subsurface water bodies, typical contaminants
- types of wells, well structures, hydraulic calculation of wells, drawdown curve
- reservoir and aquifer protection, protective area

#### **3. Surface water intake**

- typical contaminants and their variations over time and location
- typical intake structures: rivers, lakes, reservoirs
- selection of water acquisition site location and protective measures
- screen bars and sieves

#### **4. Clarification - thickening**

- sedimentation process: discrete and hindered settling, thickening curve
- hydraulic aspects of sedimentation tank
- sizing of clarifiers, structures and settling tank upgrade

#### **5. Coagulation-flocculation**

- removal of floc size particles, floc destabilization process
- mixing demand
- phase separation and process units

#### **6. Cake filtration**

- theory of cake filtration
- sieves for macro- and micro filtration
- screens, drum filters

#### **7. Filtration in porous media**

- rapid filtration: pressure and water quality changes along the filter, regulation of filtration rate, filter backwash
- slow filtration, pressure and water quality changes, operating principles, structural layout

#### **8. Disinfection**

- aim of disinfection
- oxidation by chlorine, breakpoint curve
- application of chlorine dioxide
- application of ozone
- UV disinfection
- disinfection by-product formation, prevention and reduction



**9. Degassing, aeration, acidity reduction**

- origin of methane and aggressive carbon dioxide, reduction
- Henry's law, effect of partial pressure, physical and chemical fundamentals of gas liquid equilibrium, lime-carbonic acid equilibrium
- structures and equipment for aeration and degassing

**10. Iron and manganese removal**

- origin of iron and manganese, necessity of reduction
- fundamental chemistry of iron and manganese removal
- technologies for iron and manganese reduction
- treatment of iron and manganese slurry

**11. Arsenic removal**

- occurrence of arsenic in natural waters
- necessity of arsenic removal
- technologies for arsenic removal, placement in process trains, process flow diagrams

**12. Ammonium removal**

- occurrence of ammonium in natural waters, nitrogen forms
- necessity of ammonium removal
- technologies for ammonium removal, placement in process trains, typical block diagrams

**13. Water softening**

- water hardness, fundamental definitions, aim of softening
- introduce at least four process for water softening

**14. Materials, structures and construction of drinking water distribution networks**

- requirements and legislation of materials for drinking water distribution, common structural loads
- common pipe materials and designation, fittings and joints
- structures of water towers, piping layout, maintenance
- pipe laying methods (earthworks, compaction), verification tests

**15. Primary (mechanical) wastewater treatment - screens and grit chambers**

- purpose of screens, screen types, dimensioning of screens
- grit chambers and grease trap structures and their dimensioning

**16. Primary (mechanical) wastewater treatment - primary settlers**

- primary settler structure types and layouts
- dimensioning of primary settlers, removal efficiency

**17. Activated sludge process**

- constituents of activated sludge, structure, correlation of recirculation and solid retention time
- biomass production (Monod and Andrews kinetics)
- dimensioning based on ATV 131

**18. Nitrogen removal from wastewater**

- nitrogen forms, mechanisms of nitrogen reduction, required conditions (nitrification, denitrification)
- necessity of nitrogen reduction
- possible reactor configurations
- sidestream technologies (anaerobic ammonium oxidation)

**19. Phosphorus removal from wastewater**

- phosphorus fractions
- necessity of phosphorus reduction
- chemical phosphorus removal and reactor configurations
- excess biological phosphorus removal and reactor configurations (A/O, A2/O, UCT, etc.)

**20. Fixed film wastewater treatment**

- properties of fixed film systems, life cycle and transport processes of the biofilms
- rotating contractors and biofilters
- moving bed bioreactor systems and their layouts
- integrated fix film activated sludge systems

**21. Sizing of aeration systems for wastewater treatment**

- sizing of aerators: correlation between oxygen demand of bioreactors and required airflow (AOTR, SOTR)
- surface aerators
- submerged aerators
- theory and measurement of oxygenation capacity verification, execution of the measurement

**22. Wastewater treatment in sequenced batch reactors (SBR)**

- properties, dimensioning and operation of SBR systems
- role of equalizing tanks in SBR processes

**23. Secondary settlers in wastewater treatment**

- layout, dimensioning principles (hydraulic considerations)
- sludge volume index, sedimentation curve
- operation of secondary settlers, duty point analysis

**24. Sludge treatment in wastewater treatment plants**

- properties of primary and secondary sludge
- structures and material balance of the thickening process
- structures, machinery and material balance of dewatering
- side stream processes for sludge mass reduction (Cannibal, OSA)

**25. Stabilization of wastewater sludge**

- aim and methods of stabilization
- process and structures of aerobic sludge stabilization
- process and structures of anaerobic sludge stabilization
- biogas production, composition, utilization

**26. Wastewater sludge utilization and disposal**

- exploitable materials in the sludge
- process and layout of composting solutions
- drying and incineration of sludge
- final disposal of wastewater sludge

**27. Natural wastewater treatment processes**

- properties of extensive wastewater treatment
- classification of natural wastewater treatment processes
- constructed wetland layouts
- lagoon layouts

**28. Membrane technologies in water and wastewater treatment**

- principles of membrane separation, pore size, removable materials
- membrane system setups, layout of membrane units in drinking water treatment
- membrane materials, production methods
- maintenance and cleaning of membrane

## **WATER MANAGEMENT**

### **1. Formation and characterization of river valleys**

- formation of watercourses
- characterization of rivers in their natural state (parts of the riverbed, morphological characteristics of watercourses)
- features of water, ice and sediment transport

### **2. River regulation**

- the aim and principles of river regulation (low and bankfull flow regulation)
- concept and definition of riverbed-forming discharge
- river control works, materials, construction technologies

### **3. Utilization of watercourses**

- waterway concept, features, design and maintenance
- the main parts and types of dams
- the task, operation and main structural elements of shiplocks
- basic concepts of hydropower utilization

### **4. Floods and remediation methods**

- the occurrence of floods and icy floods
- objectives and methods of flood relief
- the system of flood protection works in Hungary
- flood relief with embankments, main protection functions and facilities
- dimensions, parts and accessories of the embankments

### **5. Technical issues of flood protection**

- flood phenomena
- flood protection methods against floods exceeding the height of the embankment, wave beating, flowing water, leaching
- wave beat protection
- what to do in case of a dyke breach; localization

### **6. Organizational- issues of flood protection**

- degrees of protection, their ordination, to-dos
- institutional system of flood protection: national and territorial organization
- flood protection plans

### **7. Flood protection**

- the role of emergency storage
- the standard flood regulations
- protection against glacial floods
- maintenance of flood protection facilities
- development strategy of domestic flood protection in Hungary

**8. Soil draining (leaders)**

- the purpose and principles of agricultural and technical draining
- procedures and tools
- solutions and materials used

**9. Lowland gathering and inland excess water**

- the lowland assembly process and its characterisation
- inland excess water, conditions of its formation, inland water damage
- determination of the relevant inland flow and the flow to be drained
- maintenance and operation of inland water drainage systems, protection

**10. Inland excess water drainage systems**

- pre-design developments, water management needs
- site plan and elevation planning
- water management and crossing structures
- structures at outlets, pumping stations

**11. Municipal stormwater management**

- responsibilities of municipal water management (inland stormwater management)
- Directions of development
- technical solutions and design principles
- procedures (hydrological and hydraulic design)

**12. Erosion and erosion control**

- the phenomenon of erosion, its manifestations, erosive damage
- factors causing and influencing erosion, erosion-free slope length, slope categories, calculation of soil loss
- agricultural, forestry and technical soil protection methods

**13. Gullies**

- formation of gullies
- damages
- ways to bind them
- Artefacts

**14. Creek Control Design**

- the process of preparing a stream control plan (survey, hydrological longitudinal section, hydraulic sizing of the beds, site plan and elevation lines)
- structural design and hydraulic sizing of stream control structures

**15. Stream control and small water flow management**

- stream control principles considering natural solutions
- structural design of the structures used

**16. Irrigation**

- the role of irrigation in agricultural production
- irrigation goals, methods
- irrigation water demand, irrigation water norm and their definition
- surface irrigation
- elements, site layout, landscaping
- sprinkler irrigation
- irrigation methods, formation of fields
- sprinklers, special irrigation modes (operation irrigation, sports, sewage reception, etc.)

**17. Fish ponds**

- fish ponds and the expediency of their establishment
- biological bases, technical conditions for fish meat production
- facilities for lowland and hilly fish ponds
- carp fish ponds

**18. Concept and characterisation of the river basin district, sub-basin in the European Union Water Framework Directive (WFD)**

- purpose and criteria for the designation of bodies of water (surface and groundwater)
- characteristic properties of water bodies
- criteria for characterization of water bodies; typification of water bodies

**19. Characterisation of bodies of surface water**

- characterisation of surface water bodies according to the European Union Water Framework Directive (WFD)
- determination of hydromorphological characteristics
- determination of water management characteristics of water bodies, quantitative, chemical and ecological characteristics

**20. Characterisation of groundwater bodies**

- characterisation of groundwater bodies according to the European Union Water Framework Directive (WFD)
- designation of water bodies
- geological and hydrogeological characterisation of groundwater bodies, general description of the overlying layer
- relationship with surface water bodies, terrestrial ecosystems
- taking stock of ecosystems

**21. Effects on water bodies**

- impacts on water bodies under the European Union Water Framework Directive (WFD)
- hydromorphological effects
- point sources of pollution
- diffuse sources of pollution
- water abstractions affecting the quantitative status
- heavily modified water bodies

## **22. River Basin Management Planning**

- river basin management planning process according to the Eu Water Framework Directive (WFD)
- What are the major water management issues in the preparation of the river basin management plan?
- What is the purpose of the programmes of measures (basic and complementary measures)? How do we design them?
- Involvement of society in the implementation of the WFD.
- Economic aspects in the design of the RBM.

## **23. Aquatic environment and its protection**

- ecological laws in surface waters
- features of material circulation
- communities of life in fresh waters
- applicability of bioindication in water classification
- ecological status of surface waters
- impact of human activity on surface water status: nitrates, eutrophication, micropollutions, snow events

## **24. Wetlands and their protection**

- wetland concept, types and characteristics
- impact of human activities on wetlands: riverbed conversions, chemical pollution, habitat fragmentation, introduction of adventive species
- ecological risk assessment and assessment
- monitoring of wetlands
- our protected wetlands and potential for use
- methods of ecological restoration

## **25. Rehabilitation of wetlands**

- the purpose of the rehabilitation of wetlands, the technical characteristics of the description of the target state
- also the role and importance of monitoring in the planning of wetland rehabilitation
- basic elements of the wetlands monitoring system and aspects of monitoring timing

## **26. Disaster management**

- the concept, varieties and features of the disaster
- legal regulation, institutional system, measures and tasks of disaster management
- general rules relating to disaster-hazardous activities, protection of those with a source of danger
- special disaster management tasks of water management

**27. Remediation**

- concept of environmental damage, environmental degradation, remediation, remediation
- institutional system and legal aspects of damage control
- water quality damage control tasks of water bodies: data register, operational and territorial damage control plans, remediation practices, detection and qualification of extraordinary pollution, operational implementation of damage control, degrees of preparedness.

**28. Remediation and rehabilitation of small watercourses**

- methodological issues for the assessment of the status of watercourses under the Water Framework Directive
- causes and ways to solve problems in the case of small watercourses
- water quality protection, landscape aesthetic and ecological considerations during the preparation of the rehabilitation plan
- habitat restoration, watercourse settlement in nature