



**NEMZETI
KÖZSZOLGÁLATI
EGYETEM**
LUDOVIKA

VÍZTUDOMÁNYI KAR

FINAL EXAM TOPICS

ENVIRONMENTAL ENGINEER (BSc)



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ENVIRONMENTAL ENGINEER (BSc)

PROTECTION OF ENVIRONMENTAL ELEMENTS AND ENVIRONMENTAL TECHNOLOGIES (A1)

For all specialization

1. Environmental pollutions and their reduction

- sources
- effects and their extents, examples
- environmental elements to be protected
- definition and interpretation of ecosystem
- ecological restoration and nature conservation

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

8. Waste classification, waste management frameworks

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

9. Collection and transport of solid municipal waste

- requirements and tools of collection - pre-treatment - 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, hydrolysis, electrochemical processes, embedding, solidification

11. Thermic waste treatment processes

- classification, application possibilities and aims of thermic processes
- advantages and disadvantages of incineration 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, influencing factors of anaerobic digestion
- advantages and disadvantages 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 contaminate 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 localization 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 pollution 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 EU standards and 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 characterization
- 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 characterization 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.Characterization of bodies of surface water

- characterization 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.Characterization of groundwater bodies

- characterization of groundwater bodies according to the European Union Water Framework Directive (WFD)
- designation of water bodies
- geological and hydrogeological characterization 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