MSc Specialization in Water and Hydro-Environmental Engineering

Final exam questions

Drinking water and wastewater treatment II. (BMEEOVKMV-1)

1. Treatment of deep well waters: complex treatment methods, technological schemes, details of the treatment processes (removal of iron, manganese, arsenic, ammonium ion, dissolved gases).
2. Water quality deterioration in drinking water distribution systems: the causes and consequences of the processes taking place in the drinking water network.
3. Mechanical wastewater treatment: screening, sand trap, sieving, sedimentation. Mechanical wastewater treatment intensified by chemical treatment. Structure and design considerations of the units.
4. Activated sludge biological wastewater treatment: removal of nitrogen and phosphorous by biological and chemical processes. Reactor configurations, design aspects. Structure and design considerations of the units.

Water quality monitoring (BMEEOVKMV-2)

1. Planning of surface water monitoring systems: selection of quality parameters, delineation of the sampling network, determination of sampling frequency, data storage and data evaluation methods. Presentation of their application using an example.
2. Monitoring and classification of the ecological status of surface waters according to the Water Framework Directive (quality elements, status assessment, calculating the probability of misclassification).

Hydromophyology (BMEEOVVMV-2)

1. Theoretical description of turbulent flows, up-to-date flow measurement methods (Navier-Stokes and Reynolds equations, turbulent wall laws, ADCP measurements, hydromorphological parameter estimations)
2. Estimation of sediment load of rivers with theoretical approaches, with measurements and with empirical formula (Fick laws, vertical variation of suspended sediment concentration, sediment measurements, empirical formula)
3. Theory and measurement of riverbed morphodynamics (bed shear stress, critical flow velocities, riverbed material analysis methods, information content of riverbed samples, bedforms and their relation with the flow variables)

Modelling of Hydrosystems (BMEEOVVMV-1)

1. Modelling of rainfall-runoff. Objectives. Classification based (a) on the character of the results, (b) description of the physical processes and (c) spatial discretisation. The process of model development, calibration (methods and indicators), and the interpretation of the runoff time series with respect to the modelling objective.
2. Modelling system of wind-induced lake hydrodynamics and thermodynamics. Water motions at different scales and their modelling principles. Modelling the thermal processes of shallow lakes. Wind stress and heat fluxes at the water surface, connection to the water budget. Principles of calculating turbulent heat fluxes.

3. Modelling system of river hydrodynamics and sediment transport, resolution of the interactions. Solution of the three-dimensional governing equations using grid-based numerical methods. Basics of turbulence models of various level of complexity, basics of large eddy simulation. Classification of sediment transport modelling with respect to the character of sediment motion, calculation of bed changes.
4. Modelling of flood propagation in river networks. Sources of uncertainty and their discretisation with scenarios. Modelling support for delineating floodways, i.e., floodplain corridors with high conveyance. Procedures for linking 1D-2D models, benefits and disadvantages vs purely 1D or 2D models. Modelling design flood levels using probabilistic simulations.

Groundwater (BMEEOVVMV63)

1. The appearance and movement of water in porous medium and fractured rocks.

Design of Water Utilisation Structures (BMEEOVVMV61)

1. The aims to build hydraulic engineering structures, the main elements of them and their function and configuration, the basic questions of design and operation, illustrated with examples.