Table 5.2 Subject specification

Course specification: Forestry and Natural Resources Management			
Name of the subject: Modeling of hydraulic-hydrological and sediment transport processes in river basins			
Professor/Professors: dr Vesna D. Đukić			
Course status: elective course			
ECTS Number: 5			
Condition: -			
Purpose of subject: The purpose of the subject is to acquire knowledge about principles of mathematical modeling and to better understand hydraulic-hydrological and sediment transport processes in river basins by application of mathematical models. The important natural processes in river basins - surface runoff, erosion production of sediments and transport of sediments in the river network are mutually interrelated. The course deals with rainfall-runoff modeling, especially flash-flood modeling, open channel and flood plain hydraulics and sediment flow in river basins.			
The outcome of the subject: After finishing the course the students will acquire the ability to explain the basic concepts of mathematical modeling, to describe the basic equations of water flow and sediment flow and to solve problems of water and sediment flow. The students will understand hydraulic-hydrological and sediment transport processes in river basins and will be able to develop and create the basin model describing these processes through the model calibration and validation.			
Course content: ***Theoretical part of course.*** Introduction to problematic of mathematical modeling of water and sediment processes in river basins. Classification of problems, governing equations of fluid flow (mass conservation, momentum and energy conservation, equations of state), initial and boundary conditions, definition of the model, state variables. Review of different types of models: empirical, conceptual and physically-based models. Application of GIS tools and remote sensing data for analyzing the geospatial data. Hydrological modeling of flood runoff in the basin and modeling the components of hydrological cycle (infiltration, evapotranspiration, interception, surface runoff, subsurface runoff and groundwater runoff). Flood modeling in river network. Flood hazard assessment (determination of potentially endangered areas and possible scenarios of flood course) and assessment of flood risk zones. Modeling of sediment production, transport of sediments and sediment deposition in streams and relations between them. Calibration and validation of basin's models. The influence of conservation and adaptation measures on hydraulic-hydrological and sedimentation behavior of basins. ***Practical part of course.*** Application of different software packages for modeling of water and sediment flow in river basins. Necessary steps for creating a model: 1. DEM Preprocessing for watershed delineation using ArcGIS tools. 2. Spatial analysis and processing of spatial input data using ArcGIS Tools. 2. Determination of the hydrological model of the basin. 3. Creation of the one-dimensional hydraulic flood model. Determination of water surface profiles for steady water flow. 4. Determination of flood hazard maps and flood risk maps. 4. Creation of the one-dimensional sediment transport model. 5. Comparisons and analyses of different sediment transport equations. 6. Identification of vulnerable locations within the basin and the river network where erosion or sediment deposition can occur. 7. Application of GIS tools for displaying and presenting the spatial patterns of the model results. 8. The evaluation of model's performance using statistical criteria.			
Literature: Đukić, V., Erić, R. (2021): *SHETRAN and HEC HMS Model Evaluation for Runoff and Soil Moisture Simulation in the Jičinka River Catchment (Czech Republic).* Water, MDPI, 13, 6, 2073-4441, 10.3390/w13060872 Đukić, V., Erić, R., Dumbrovsky, M., Sobotkova, V. (2021): *Spatio-temporal Analysis of Remotely Sensed and Hydrological Model Soil Moisture in the Small Jičinka River Catchment in Czech Republic*. Journal of Hydrology and Hydromechanics, 69, 1, pp. 1 - 12, 0042-790X, 10.2478/johh-2020-0038. Đukić, V., Radić, Z. (2016) Sensitivity analysis of a Physically Based Distributed Model. Water Resources Management 30: 1669-1684. DOI 10.1007/s11269-016-1243-8. http://link.springer.com/article/10.1007/s11269-016-1243-8 Đukić, V., Radić, Z. (2014): GIS Based Estimation of Sediment Discharge and Areas of Soil Erosion and Deposition for the Torrential Lukovska River Catchment in Serbia, Water Resources Management 28 (13), p.4567-4581.http://link.springer.com/article/10.1007/s11269-014-0751-7 Lindel, J., Moore, W., King, H. (2017) Handbook of Hydraulics. pp. 416. McGrow – Hill. ISBN: 978-1259859687 Maidment David R. (1993) Handbook of Hydrology. pp. 1424. Mc Grow – Hill. ISBN-13: 978-0070397323			
Number of active teaching lessons: 60	**Theoretical part of teaching:** 30	**Practical part of teaching:** 30	
Methods of teaching: Lectures, exercises, seminar papers			
Assessment of knowledge (maximum number of points 100)			

Pre-exam obligations	points	**Final exam**	points
Lectures presence and activity	10	Written exam	25
Seminar paper	20	Oral exam	25
Tests	20		