Module Handbook of Management of Drainage Basin

Module designation	Watershed Management Master Program Lectures are structured with the aim that students are able to understand about: 1. Characteristics and advantages of watersheds in the context of sustainable and sustainable environmental management with a geographical approach. 2. The influence of climate change on watersheds, analysis techniques and countermeasures. 3. Watershed management planning is based on theoretical concepts and geographical approaches. The Watershed Management course is an interest elective course offered in Semester 2 in the Geography Masters study program. This course explains the characteristics, advantages and techniques of watershed-based analysis, the effects of climate change, disasters and types of watershed conservation, mitigation and adaptation, and approaches, types/types of watershed management and planning. There are 14 DAS management meetings, consisting of 10 material sessions, 2 assignment sessions, and 2 exam sessions. Lectures are taught by a team of supporting lecturers, namely Prof. Dr. Slamet Suprayogi, Dr. M. Pramono Hadi, and Dr. Dyah Rahmawati Hizbaron. Sessions 1 – 3 taught by Prof. Dr. Slamet Suprayogi with the aim of introducing the characteristics and advantages of watersheds in the context of sustainable and sustainable environmental management using a geographical approach. Session 4 – 6 taught by Dr. M. Pramono Hadi, with the aim of identifying the effects of climate change on watersheds, analysis techniques and efforts to mitigate them. As well as sessions 7-10 taught by Dr. Dyah Rahmawati Hizbaron with the aim of understanding watershed management planning based on theoretical concepts and geographical approaches.
Semester(s) in which the module is taught	Odds/ First (1st) Semester
Person responsible for the module	Prof. Dr. Slamet Suprayogi, M.S Dr. M. Pramono Hadi, M.Sc Dr. Dyah Rahmawati Hizbaron, S.Si, M.T., M.Sc
Language	Bahasa Indonesia

Relation to curriculum	Cross Disciplines (MBKM)						
Teaching methods	SCL: Student Centered Learning *(Team-based Project)* *TCL: Teacher Centered Learning*						
Workload (incl. contact hours, self-study hours)	**CLO 1**	Interactive lectures and case discussions	3 meetings 4 x 50 minutes of classroom lectures and discussions 4x60 minutes of structured assignments 4x60 minutes independent study activities				
	CLO 2	Interactive lectures and practice	2 meetings 2 x 50 minutes of classroom lectures and discussions 2x60 minutes of structured assignments 2x60 minutes independent study activities				
	CLO 3	Interactive lectures, case discussions, presentations	4 meetings 4 x 50 minutes of classroom lectures and discussions 4x60 minutes of structured assignments 4x60 minutes independent study activities				
	CLO 4	Interactive Lectures, Presentations, Discussions, Peer Assessment Project Idea Assignments).	3 meetings 3 x 50 minutes of classroom lectures and discussions 3x60 minutes of structured assignments 3x60 minutes independent study activities				
Credit points	**Assessment Techniques**	**Percentage of Assessment (%)**	**Criteria/ Indicators**	***CLO (%)***			
				1	***2***	**3**	**4**
	Participatory Activities*)	10%	Contribution of class discussion activities in each subject matter of the lecture				**10%**
	Project Results/ Case		Complete case study reports are				

	Study Results/ PBL Results*)		available				
	Cognitive						
	Assignment	10%	The results of the task are available and complete		**5%**	**5%**	
	Mid-term	40%	Students answer the questions correctly	**10%**	**10%**	**10%**	**10%**
	Final Exam	40%	Students answer the questions correctly	**10%**	**10%**	**10%**	**10%**
	Total	100%		**20%**	**25%**	**25%**	**30%**
	*) can be obtained from Mid-term or Final exams which are the results of participatory activities or the results of projects/case studies. By IKU 7, the total percentage of participatory activities and project results/case studies/PBL at least 10%.						
Required and recommended prerequisites for joining the module							
Module objectives/intended learning outcomes	**PLO A1**	Understand the material and formal objects of geography in order to solve problems resulting from the imbalance of interaction between geographical components.					
	PLO B1	Mastering the application of geography to manage the environment and human resources in rural, urban, watershed, coastal and marine areas through spatial, ecological and regional complex approaches.					

	CLO 1	Understand the characteristics, priorities and analysis techniques for watersheds or watersheds. [PLO A1]
	CLO 2	Identify problems that occur in watersheds either due to climate change, disasters or technological failures as well as the types of conservation, mitigation and adaptation needed. [PLO A1]
	CLO 3	Designing sustainable management and planning ideas for watersheds through critical thinking and system thinking to solve watershed problems with a multidisciplinary collaborative geographical approach. [PLO B1]
	CLO 4	Reflecting the right solutions to problems in the industrial 4.0/society 5.0 era and the impacts that will occur and increasing self-regulated learning skills as part of efforts to become lifelong learners. [PLO B1]
Content	**CLO 1**	1. Watershed characteristics; a. Watershed component b. Watershed system boundary c. Hydrological System d. Geomorphological System e. Climatic System f. Anthropocentrism System g. The iterative nature of the ecosystem h. The reciprocal nature of man and nature 2. Watershed priority; a. Keeper of the ecosystem balance b. Fulfillment of domestic and non-domestic water needs c. Sustainable food supply 3. Watershed management analysis techniques a. Spatial data types and statistics b. Type of analysis of water debit, water balance, rainfall value, disaster risk, population pressure, etc. c. Deterministic and probabilistic modeling techniques
	CLO 2	1. Effects of climate change and disasters on watersheds; a. Water balance disturbance b. Land degradation and criticality c. Risk of flood and drought disaster 2. Types and types of conservation, mitigation, and adaptation in the watershed a. Watershed conservation type

		b. Watershed mitigation type c. Types of watershed climate change adaptation
	CLO 3	1. Watershed management approach; a. Spatial and temporal approach b. Environmental approach c. Territorial complex approach 2. The basic concept of watershed management; a. Integrated Watershed Management; b. Integrative Watershed Management; c. Multi-risk watershed management d. Watershed Management Based on Climate Change Adaptation; 3. Watershed management theory a. Environmental Carrying Capacity Theory, b. Environmental Resilience Theory, c. Sustainability Theory, 4. Watershed planning a. Problem formulation b. Identify alternative scenarios c. Trend analysis based on historical data d. Planning scenario e. Technocratic planning f. Participatory planning
	CLO 4	1. Watershed Management a. Watershed institutions b. Watershed monitoring c. Watershed evaluation 2. Presentation of Phase Group Tasks (Group work begins at the 7th meeting before UTS, and continues at the 13th meeting, then is presented at the 14th meeting)
Examination forms	Mid-term and Final Exam	

Study and Examination Requirements	Student participation 10%, Project result, Assignment 10%, Summative Test (Mid-term and Final Exam) 80%
Reading list	**Main:** Bruins, R. J. F., & Heberling, M. T. (2005). *Economics and ecological risk assessment : applications to watershed management*. CRC Press. Darghouth, S., Ward, C., Gambarelli, G., Styger, E., & Roux, J. (2008). Watershed management approaches, policies, and operations: Lessons for scaling up. *Water Sector Board Discussion Papers*, *11*, 1–164. http://documents.worldbank.org/curated/en/2008/05/9608907/watershed-management-approaches-policies-operations-lessons-scaling-up%5Cnhttp://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2008/06/26/000020439_20080626162646/Rendered/PDF/442 Lyon, J. (2003). *GIS for Water Resources and Watershed Management*. Hizbaron, D. R. (2016). *Menuju kota tangguh di sungai code Yogyakarta: perencanaan integratif perkotaan dengan pendekatan pengelolaan DAS dan pengurangan risiko bencana*. Gadjah Mada University Press. https://books.google.co.id/books?id=xzkoswEACAAJ Kumar, M., Denis, D. M., Singh, S. K., Szabó, S., & Suryavanshi, S. (2018). Landscape metrics for assessment of land cover change and fragmentation of a heterogeneous watershed. *Remote Sensing Applications: Society and Environment*, *10*, 224–233. https://doi.org/10.1016/j.rsase.2018.04.002 Lal, R. (2000). *Integrated Watershed Management in the Global Ecosystem*. Michielsen, A., Kalantari, Z., Lyon, S. W., & Liljegren, E. (2016). Predicting and communicating flood risk of transport infrastructure based on watershed characteristics. *Journal of Environmental Management*, *182*, 505–518. https://doi.org/10.1016/j.jenvman.2016.07.051 Parkes, M. W., Morrison, K. E., Bunch, M. J., Hallström, L. K., Neudoerffer, R. C., Venema, H. D., & Waltner-Toews, D. (2010). Towards integrated governance for water, health and social-ecological systems: The watershed governance prism. *Global Environmental Change*, *20*(4), 693–704. https://doi.org/10.1016/j.gloenvcha.2010.06.001 Schlager, E., & Blomquist, W. (2008). *Embracing Watershed Politics: Vol. 1st Edition*. University Press of Colorado. Shaw, R., Srinivas, H., & Sharma, A. (2009). *Rajib Shaw - Urban Risk Reduction_ An Asian Perspective (Community Environment and Disaster Risk Management) (2009): Vol. 1st Edition*. Emerald Group Publishing Limited.

	Sitterson, J., Knightes, C., Parmar, R., Wolfe, K., Muche, M., & Avant, B. (2017). An Overview of Rainfall-Runoff Model Types.Athens, Georgia: United States Environmental Protection Agency (EPA). Harsoyo, B. (2010). Review Modeling Hidrologi DAS di Indonesia. Jurnal Sains dan Teknologi Modifikasi Cuaca, 11(1), 41-47. von-Bertalanffy, L. (1972, December). The History and Status of General System Theory. Academy of Management Journal, 15(4), 407-426. Pahl-Wostl, C., Jeffrey, P., Isendahl, N., & Brugnach, M. (2011, November). Maturing the New Water Management Paradigm: Progressing from Aspirations to Practice. Water Resource Management, 25, 837-856. Fath, B. D. (2017). System Ecology, Energy Networks, and Path to Sustainability. International Journal of Design and Nature and Ecodynamics, 12(1), 1-15. Munangsinghe, M., & Lutz, E. (1993). Environmental Economics and Valuation in Development Decision Making. In M. Munasinghe, Environmental Economics and Natural Resource Management in Developing Countries (pp. 17-72). Washington: The World Bank & Committee of International Development Institute on the Environment (CIDIE).
	Additional: