Table 5.2 Specification of Course

Study Program: **Material and Energy Flows Management**				
Type and level of study: Master Academic Degree				
Name of Course: INDUSTRIAL ECOLOGY AND ZERO EMISSION				
Lecturer: Bojana Ikonić and Jelena Pavličević				
Status of Course: mandatory				
Credits (ECTS): 6				
Preconditions: none				
Aims of the Course Industrial Ecology, as interdisciplinary research field, enables to understand management of human activity on a sustainable basis by minimizing energy and materials usage, ensuring acceptable quality of life for people, minimizing the ecological impact of human activity to levels natural systems can sustain, conserving and restoring ecosystem health and maintaining biodiversity and maintaining the economic viability of systems for industry. The ideas of industrial ecology are based on sustainable principles from nature and their adaption to technical development, providing systems-based view of how, where, and why environmental improvements and targets on national, regional and local levels can be made to move towards an environmentally sustainable economy.				
Outcomes/Competences of the Course Students are trained to understand theoretical and practical basis of industrial ecology and deepen their knowledge in the field of material and energy flow analysis, in order to provide nature integrated technologies and cleaner production profoundly more efficient, less dependent upon non renewable resources and less polluting. Students are prepared to apply the zero emission model, to predict the circulation of material flows and reduce the emission of material and energy to a minimum, ideally zero. The course provides the knowledge about the different case studies in the field of circular economy and zero emission.				
Description of the Course Content Theoretical foundation and nature based principles of industrial ecology and industrial metabolism; Process analysis approach to industrial ecology, material and energy flows and cleaner production; Examples of tools in industrial ecology: life cycle analysis, environmental risk assessment, life cycle costing and cost-benefit analysis; Input-Output Economics in Industrial Ecology; International case studies and national approaches of eco-industrial symbiosis and projects; Case studies on cycling strategies and technologies; Nutrients recovery: phosphorus, nitrogen, carbon capture and soil conservation; Biorefinery and renewable material production; Industrial ecology management; Basic principles of zero emission (ZE) approach and circular economy (CE); Current global ZE and CE trends; Industrial ecology and zero emission: governance, laws and regulations; Overview of the environmental administration, environmental problems and policies in key countries like USA, Japan, China and Europe; Industrial ecology and integrated assessment: an integrated modeling approach for climate change; Case studies on climate protection projects in EU; Different approaches on sustainable development at national/international level.				
Required Readings 1. Graedel, Tom H.; Allenby, Braden R.; Graedel, T.E. Industrial Ecology and Sustainable Engineering. Prentice Hall, 2009. 2. Ibrahim Dincer, Marc Rosen; "EXERGY: Energy, Environment and Sustainable Development", Elsevier 2007.				
Lessons				Other hours
Theory: 45	Practice:30	Other:	Research work	
Teaching Methods Lectures and students group work				
Grade (maximal number of points: 100)				

Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during the lectures	10	Oral exam	30
Test I and Test II	40		
Seminar paper	20		