

Lecture 3 h each, mixture with interactive lecture and exercises Draft 12.4.2023	Lecture	Exercise	Lecturer	Deadlines
1 Wed 26.4.2023 13 – 16	Course introduction Introduction to modelling and simulation Modelling procedure	Introduction with SUMO Hydraulics in plant models (SUMO)	Henri Heimi /Anna Mikola	
2 Fri 28.4.2023 8:30-12	Modelling biological phenomena: Typical expressions for process kinetics, biological models, mass balances Model structure, Gujer matrix SUMO exercises Activated sludge models	Basic NR process model and simulations Introduction of the individual project topics, Selection of project topics Homework 1 with SUMO	Henri Haimi	Select your personal project work topic
3 Wed 3.5.2023 13 – 16	Influent fractions and characterization, nutrient removal processes Dynamic simulations Model calibration Calibration tools Sensitivity of parameters Assessment of the selected parameters	SUMO homework 2	Anna Mikola /Henri Haimi Sylvie Gillot	
4 Fri 5.5.2023 8:30-12.	Physical phenomena: Phase separation, gas transfer, Chemical precipitation, pH	Personal project assignment SUMO homework 3	Anna Mikola/Henri Haimi	Get to know SUMO quiz
Wed 10.5.2023 13 - 16	No lecture			
5 Fri 12.5.2023 8:30-12	Klaukkala WWTP visit, questions to the plant		Matias Niemi	
6 Wed 17.5.2023 13 -16	Introduction to process control – Goals and strategies: disturbances and manipulated variables	Alternative designs and operation strategies, SUMO exercise for controllers, personal project assignment Exam 1 Exercise (cost calculation)	Michela Mulas	DL HW1 Client- consultant meeting 1 EXAM 1
7 Fri 19.5.2023 8:30-12.00	Feedback control: algorithms and tuning methods	Project work	Michela Mulas	DL HW2

8 Wed 24.5.2023 13 – 16.30	More advanced control systems, cascade controllers and model based control I Advanced control systems II Future of control	SUMO homework 4	Michela Mulas Henri Haimi	
9 Fri 26.5.2023 8.30 – 12	Gas transfer, Energy and cost in modeling, example: aeration control, LCA, CO2 footprint? Instrumentation, analysers	Project work	Sylvie Gillot Riku Laitinen E+H	DL HW 3
10 Wed 31.5.2023 13 – 16:30	Automation, instrumentation and process control during plant design and start-up, PI schemes	Exercises on advanced control systems, personal project assignment	Teemu Koskinen Ramboll	Client-consultant meeting 2
11 Fri 2.6.2023 8:30-12	Exam Summary	Finalizing the presentations Written exam on control;	Anna Mikola	Exam 2
Mon 5.6.2023 14 – 16:30	Students' presentation			Presentations
Wed 7.6.2023 14 – 16:30	Students' presentation	Course feedback discussion		Presentations
				DL HW 4
Fri 9.6.2023				Written reports