

Lecture 3 h each, mixture with interactive lecture and exercises	Lecture	Exercise	Lecturer	Deadlines
1 Wed 21.4.2021 13-16.30	Course introduction Introduction to modelling and simulation Modelling procedure	Introduction with SUMO Hydraulics in plant models (SUMO)	Anna Mikola	
2 Fri 23.4.2021 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	Anna Mikola	Select your personal project work topic
3 Wed 28.4.2021 13-16.30	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 Kristian Sahlstedt AFRY	
4 Fri 30.4. 2021 9 - 12	Physical phenomena: Phase separation, gas transfer, Chemical precipitation, pH	Model calibration demo, personal project assignment SUMO homework 3	Anna Mikola	Get to know SUMO quiz
5 Wed 5.5.2021 13- 16.30	Klaukkala WWTP, questions to the plant Introduction to process control – Goals and strategies: disturbances and manipulated variables	SUMO exercise for controllers, personal project assignment	Anna Mikola Michela Mulas	Client- consultant meeting 1 DL HW1
6 Fri 7.5.2021 8:30- 12		Exam 1 Project work Exercise (cost calculation)	Anna Mikola	EXAM 1
7 Wed 12.5.2021 13-16.30	Feedback control: algorithms and tuning methods	Alternative designs and operation strategies,	Michela Mulas	DL HW2
8 Wed 19.5.2021 13 – 16.30	More advanced control systems, cascade controllers and model based control I	SUMO homework 4	Michela Mulas	Client- consultant meeting 2

9 Fri 21.5.2021 8.30 – 12	Energy and cost in modeling, example: aeration control	Project work	Petri Ukkonen Anna Mikola	DL HW 3
10 Wed 26.5.2021 13 – 16:30	Automation, instrumentation and process control during plant design and start-up, PI schemes Instrumentation, analysers Advanced control systems II	Exercises on advanced control systems, personal project assignment	Teemu Koskinen Ramboll Pasi Puranen, Hyxo Michela Mulas	
11 Fri 28.5.2021 8.30 – 12	Future of control Exam Summary	Finalizing the presentations Written exam on control; Course feedback discussion	Henri Haimi Anna Mikola	DL HW 4 Exam 2
Wed 2.6.2021 13 →	Students' presentation			Presentations
Fri 4.6.2021				Written reports