

Lecture 3 h each, mixture with interactive lecture and exercises	Topic	Exercise	Lecturer	Deadlines
1 Wed 17.4. 13- 16.30	Course introduction Introduction to modelling and simulation Modelling procedure	Introduction with SUMO Hydraulics in plant models (SUMO)	Anna Mikola	
2 Wed 24.4. 13 – 16.30	Modeling 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 Homework 1 with SUMO	Anna Mikola	
3 Fri 26.4. 8.30 - 12	Influent fractions and characterization, nutrient removal processes Dynamic simulations Physical phenomena: Phase separation, gas transfer, Chemical precipitation, pH	SUMO exam, Selection of project topics, SUMO homework 2	Anna Mikola	SUMO exam
4 Fri 3.5. 8.30 - 11.30	Excu to Klaukkala WWTP		Anna Mikola	
5 Wed 8.5. 13- 16.30	Model calibration Calibration tools Sensitivity of parameters Assessment of the selected parameters	Model calibration demo, personal project assignment SUMO homework 3	Anna Mikola Kristian Sahlstedt Pöyry	DL HW1 Select your personal project work topic
6 Fri 10.5. 8.30 – 12	Energy, GHG and cost in modeling, example: aeration control Exercise (cost calculation)	Written exam of the basics on modelling personal project assignment	Diego Rosso	Exam 1
Sun 12.5.				DL HW 2
7 Wed 15.5. 13 – 16.30	Introduction to process control – Goals and strategies: disturbances and manipulated variables	SUMO exercise for controllers,	Michela Mulas	
8 Fri 17.5. 8.30- 12	Feedback control: algorithms and tuning methods	Alternative designs and operation strategies, personal project assignment SUMO homework 4	Michela Mulas	
Mon 20.5. 8:30 - 12	Automation, instrumentation and process control during		Teemu Koskinen	

	plant design and start-up, PI schemes More advanced control systems, cascade controllers and model based control I		Ramboll  Michela Mulas	
9 Wed 22.5. 13 – 16.30	Instrumentation, analysers	Exercises on advanced control systems, personal project assignment	Michela Mulas Pasi Puranen, Hyxo	DL HW 3
10 Fri 24.5. 8.30 – 12	Advanced control systems II Future of control Exam Summary	Finalizing the presentations Written exam on control; Course feedback discussion	Henri Haimi OK Anna Mikola Michela Mulas	Exam 2
Mon 27.5. 8.30 - 12	Students' presentation			Presentations
Fri 31.5.				DL HW 4 Written reports