

Course-PM 2020

ACE085 Water systems and modelling (7.5 hp)

# Course purpose

The aim of the course is to provide students with an understanding of problem solving and modelling in the field of water systems.

# Learning objectives:

* Understand the hydraulic, hydrodynamic and pollutant transport processes in natural and constructed water systems
* Distinguish between different models, considering both simple and advanced models
* Be able to select and use an appropriate model for a given analysis to assess the quantity and quality of water, including model calibration, validation and uncertainty
* Evaluate appropriate input values for the model parameters of the models considered, and to appreciate the sensitivity of the simulation results to the selected parameter values
* Write a scientific paper
* Carry out a literature review
* Assess and give constructive feedback on other projects group's work:
  + a. Critically evaluate used methods with consideration to scientific trustworthiness
  + b. Interpret and assess the quality of the results
  + c. Evaluate whether research has been carried out in a trustworthy and defensible manner

# Contact details

Course is offered by the department of Architecture and Civil Engineering

Examiner:

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Teachers:

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Please use email to contact the teachers.

# Course design

The course consists of several lectures and exercises, one individual assignment and one group project.

***Lectures and exercises***

Lectures and exercises cover central topics in the course. Exercises illustrate how various models can be used to model water systems. Lectures and exercises will give support to both the group work and the individual assignment. The exercises are solved in groups of two students. The exercises are graded pass or fail. Support to solve the exercise is given during the scheduled sessions.

To hand in your report. First both students join a group for each exercise. Once both students have joined the group, hand in the assignment.

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| **Exercise** |  | **Program** | **Deadline** | **Feedback teacher** |
| **Ex1** | Compartmental modelling |  |  |  |
|  | Attendance and grading in classroom *or* report handed in. Instructions in a separate document. | Matlab | At 18.00 10/9 | 17/9 |
|  | | | | |
| **Ex2** | Numerical modelling | Matlab |  |  |
|  | Attendance and grading in classroom *or* report handed in. Instructions in a separate document. |  | At 18.00 14/9 | 21/9 |
|  | | | | |
| **Ex3** | Ex: Hydrodynamic modelling | MIKE 3 FM |  |  |
|  | Attendance at both sessions and grading in classroom *or* Report handed in. Instructions in a separate document. |  | At 18.00 21/9 | 28/9 |
|  | | | | |
| **Ex4** | Wastewater process modelling | Python |  |  |
|  | Report handed in. Instructions in a separate document. |  | At 18.00 28/9 | 5/10 |
|  | | | | |
| **Ex5** | Statistics - exploratory data analysis | Matlab |  |  |
|  | Report handed in. Instructions in a separate document. |  | At 18.00 8/10 | 22/10 |
|  | | | | |
| **Ex6** | Bioinformatics for water engineers | Python |  |  |
|  | Attendance and grading in classroom *or* report handed in. Instructions in a separate document. |  | At 18.00 26/10 | 2/11 |

***Individual assignment***

The assignment addresses the following learning outcomes (adjusted to the individual assignment task):

* Understand hydraulic, hydrodynamic and pollutant transport processes in natural and constructed water systems
* Distinguish between different models, considering both simple and advanced models
* Evaluate choices of models for a given analysis, including model calibration, validation and uncertainty
* Evaluate appropriate input values for the model parameters of the models considered, and to appreciate the sensitivity of the simulation results to the selected parameter values
* Carry out a literature review
* Assess and give constructive feedback

The assignment will be sent to ‘Urkund’ (Plagiarism control). The assignment is graded (Fail, 3, 4, 5). Write maximum 2000 words (not included references) and use at least 10 different scientific journal papers as references. Only using references provided within the course gives a lower grade. You peer review one draft of another student assignment. Use the template provided at the course homepage.

* Identify one problem that has been solved/addressed with digitalisation within the water sector
* Briefly describe the background to the identified/selected problem
* Describe how digitalisation has been used to solve the selected problem
* Reflect on the advantages and limitations of the suggested approaches
* Discuss the ethical issues that need to be considered

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| **Mandatory Tasks** | **Deadlines** |
| Submit draft (Send to peer review) | At 18.00, 10th of September |
| Send reviewed draft back to author | At 13.00, 15th of September |
| Final submission of revised individual assignment for grading | At 18.00, 22nd of September |

***Group project***

The group project is carried out in teacher assigned groups of 3-4 students. See separate document for further information on the group project.

You are expected to:

* Organise, plan and manage the project work load according to the tasks and the members of the group
* Collaborate professionally according to the project group's needs of structured management and task distribution

The group project will be checked for plagiarism using Urkund. The group project is graded (Fail, 3, 4, 5). The table below is designed to guide the work on the project.

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| --- | --- |
| **Suggested tasks to complete before each consultation** | **Suggested date when completed** |
| Formulate aim of the project, create a conceptual model, identify the required data, list the scenarios to be simulated | 24/9 |
| Write Introduction in your paper  Set-up the model, simulate first scenarios | 29/9 |
| Write Methods in your paper  Improve the model, simulate scenarios | 6/10 |
| Write Results and Discussion in your paper  Analyse results | 13/10 |
| Complete your paper with Conclusions and Abstract  Prepare an outline of your presentation | 20/10 |

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| **Mandatory Tasks** | **Deadlines** |
| Submit paper (Send paper to reviewers) | At 18.00, 13th of October |
| Group sends reviewed paper back to authors | At 18.00, 18th of October |
| Presentation of results | At 10 – 12, 22nd of October |
| Hand in final paper | At 18.00, 25th of October |

***Computer Software***

We will use Matlab, Python and MIKE 3 FM in the course.

# Course literature

The course literature consists of documents and scientific articles. These can be found on Canvas.

# Examination

Written individual assignment (graded). Computer exercises (Pass/Fail). Project work is reported in a written scientific paper (graded). Perform a clear oral presentation of the project result that is well-suited to its intended audience. Assess and give constructive feedback to other individual assignments and project group's work and scientific paper.

# Course schedule

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| --- | --- | --- | --- | --- |
| **W1** | **Time** |  |  | **Teacher** |
| 31/8 | 8-12 | Le | Introduction & compartmental modelling | MB |
| 1/9 | 8-10 | Le | Read one journal paper before this session. Academic writing, research ethics and start of individual assignment | MB |
| 3/9 | 8-10 | Le | Transport in fluids, partial differential equations and numerical solutions | MB |
| 3/9 | 10-12 | Ex1 | Compartmental modelling | MB |
|  | | | | |
| **W2** |  |  |  |  |
| 7/9 | 8-12 | Ex2 | Numerical modelling | MB |
| 10/9 | 8-10 | Le | Hydrodynamic modelling (pre-recorded) | ES |
| 10/9 | 10-12 | Ex3 | Hydrodynamic modelling, MIKE | ES, EG |
|  | | | | |
| **W3** |  |  |  |  |
| 14/9 | 8-10 | Le | Use the time to work on your model - Water quality modelling | - |
| 14/9 | 10-12 | Ex3 | Water quality modelling, MIKE | ES, EG |
| 15/9 | 8-10 | Le | Giving feedback, read and give feedback. Read the assigned individual assignment before this session. | MB |
| 17/9 | 8-10 | Le | Wastewater lectures | MN |
| 17/9 | 10-12 | Ex4 | Wastewater process modelling | MN |
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| **W4** |  |  |  |  |
| 21/9 | 8-12 | Ex4 | Wastewater process modelling | MN |
| 22/9 | 9-10 | Ex | Group work, division into groups and introduction | MN, EG, MB |
| 24/9 | 10-12 | Ex | Workshop on group work, important that your group attends | MN, EG, MB |
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| **W5** |  |  |  |  |
| 28/9 | 8-12 | Le/Ex5 | Statistics - exploratory data analysis | KM |
| 29/9 | 9-10 | GW | GW consultation | MB, EG, MN |
| 1/10 | 8-12 | Ex5/Le | Statistics - exploratory data analysis | KM |
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| **W6** |  |  |  |  |
| 5/10 | 8-12 | Le | Invited lecturers | EG |
| 6/10 | 9-10 | GW | GW consultation | MB, EG, MN |
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| **W7** |  |  |  |  |
| 12/10 | 8-12 | Le | Invited lecturers | EG |
| 13/10 | 9-10 | GW | GW consultation | MB, EG, MN |
| 15/10 | 8-12 | Le | Bioinformatics for water engineers | MA |
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| **W8** |  |  |  |  |
| 19/10 | 8-12 | Ex6 | Bioinformatics for water engineers | MA |
| 20/10 | 9-10 | GW | GW consultation | MB, EG, MN |
| 22/10 | 10-12 | Le | Presentations – mandatory attendance! | MB, EG, MN |