

CIVL4100N – Energy System Modeling for Buildings and Cities

Syllabus

Instructor

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Teaching Assistant

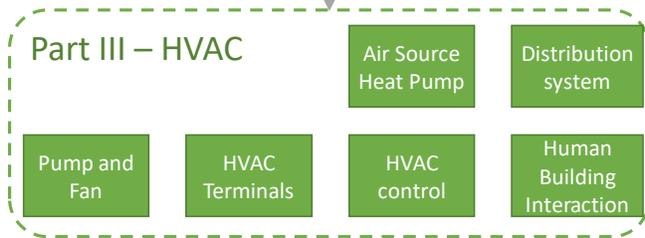
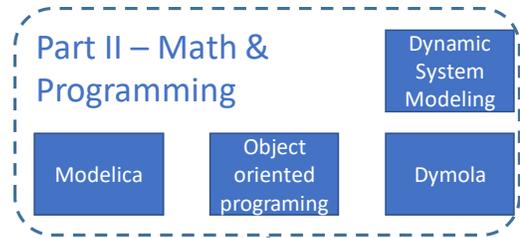
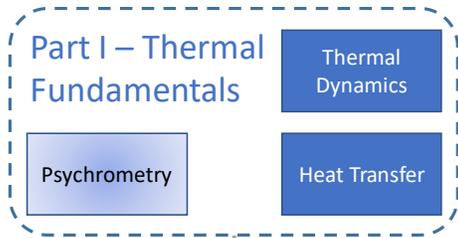
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Course description

Energy system is an important part of smart low-carbon buildings and cities. Energy system modelling is the prerequisite for load prediction, energy efficiency design and optimization, which becomes increasingly important under the context of climate change and sustainable development.

This course provides theory and hands-on experience about energy system modelling for buildings and cities. Lectures will cover physical concepts, mathematical laws, and software tools for city and building energy system modelling. On the theory side, this course will cover heat transfer basics and building thermal dynamics. On the practical side, this course will introduce the equation-based programming language Modelica. On the scale side, this course will cover building-scale energy system (HVAC) and the city-scale energy system (district heating and cooling system).

This course has four modules as shown below: review of thermal fundamentals, math and programming of dynamic systems, major components of HVAC system, and energy system modeling at different scales.



Calendar

Week	Date	No.	Lecture	Assignment
1	8 th Feb.	1	Introduction	
	10 th Feb.	2	Review I - Thermal dynamics	
2	15 th Feb.	3	Review II - Heat transfer I	
	17 th Feb.	4	Review III - Heat transfer II	H1 released
3	22 nd Feb.	5	Room level thermal dynamics	
	24 th Feb.	6	Dynamic system modeling I	H1 due
4	1 st Mar.	7	Dynamic system modeling II	
	3 rd Mar.	8	Modelica I – introduction	
5	8 th Mar.	9	Lab1. Solving ODE and PDE	
	10 th Mar.	10	HVAC overview	
6	15 th Mar.	11	HVAC heat source	
	17 th Mar.	12	HVAC heat pump I	H2 released
7	22 nd Mar.	13	Lab2. Simple envelope model	
	24 th Mar.	14	Modelica II – OOP	H2 due
8	29 th Mar.	15	Lab3. Using MixedAir model	
	31 st Mar.	16	HVAC heat pump II	
9	5 th Apr.		<i>Holiday</i>	
	7 th Apr.	17	Lab4. Building energy modeling	MH released
10	12 th Apr.	18	HVAC distribution system	
	14 th Apr.		<i>Mid term break</i>	MH due
11	19 th Apr.	19	Pump and fan	
	21 st Apr.	20	HVAC terminal	
12	26 th Apr.	21	Human building interaction	
	28 nd Apr.	22	HVAC control	H3 released
13	3 rd May	23	District heating and cooling system I	
	5 th May	24	District heating and cooling system II	H3 due
14	10 th May	25	Course Review	

Grading

- Assignments: 10%*3
- Project: 20%
- Final exam: 50%

Assignments

Three homework assignments let you practice and apply the concepts learned in lecture and section. They will usually be released on Thursday night and be due the following Thursday midnight (23:59 pm).

Assignment late policy

All assignments must be turned in on time (deadline is 23:59 pm Thu.). We will allow a total of five late days (Weekends and holidays counted) cumulatively. We will not make any additional allowances for late assignments: the late days are intended to provide for exceptional circumstances, and students should avoid using them unless absolutely necessary. Any assignments that are submitted late (with insufficient late days remaining) will not be graded.

Project

The project is aimed to let you practice and apply the concepts of building energy system modeling and the Modelica language learned in lecture and lab sessions. 2 people will form a group. You need to present your project and submit a project report by the end of the semester.

Integrity

Cheating is not allowed for either assignments or exams.

All assignments should be done individually. You are allowed to discuss homework questions with other students, but not allowed to copy solutions or share your solution to a question with other students who haven't completed the question already. Cheating on assignments or final exam results in 0 points, so you really do not want to cheat.

Please, do your own work. Thank you!

Citizenship

A diversified, inclusive and equitable environment would benefit everyone of our community. For exceptionally rude or disrespectful behavior toward the course staff or other students, your final grade will be lowered by up to a full letter grade (e.g., from an A- to a B-) at the discretion of the course instructors. You don't need to be concerned about this policy if you treat other

human beings with even a bare minimum of respect and consideration and do not engage in behavior that is actively harmful to others.

Office hour

- Time: 3-5 pm every Wed.
- Venue: Room 3564

Reference

- Stanford, H.W. and Spach, A.F., 2019. Analysis and Design of Heating, Ventilating, and Air-Conditioning Systems. CRC Press. (electronic version is available in the HKUST library)
- Modelica by Example: <https://mbe.modelica.university/>