CIVL4100N – Energy System Modeling for Buildings and Cities

Syllabus

Logistics

- Class
  - Time: 10:30-11:50 am Tue. & Thu.
  - Venue: Academic Building Room 5562
- Office hour
  - Time: 3:00-5:00 pm every Wed.
  - Venue: Room 3564

Instructor

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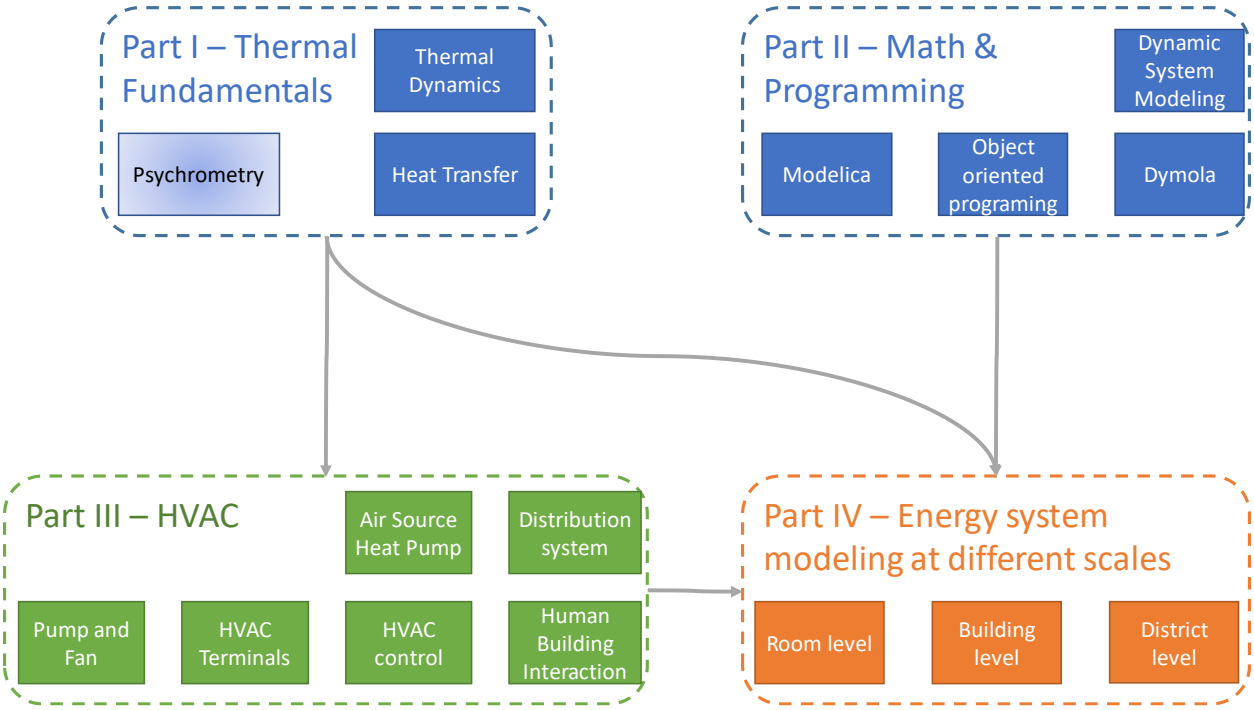
Course description

The energy system plays a vital role in smart, low-carbon buildings and cities. Modeling the energy system is a fundamental step for predicting loads, designing energy-efficient solutions, and optimizing performance. This becomes even more crucial in the face of climate change and the pursuit of sustainable development.

This course offers both theoretical knowledge and practical experience in energy system modeling for buildings and cities. The lectures will delve into the underlying principles, mathematical laws, and software tools used in modeling energy systems for cities and buildings. From a theoretical standpoint, the course will explore the fundamentals of heat transfer and building thermal dynamics. In terms of practical applications, the course will introduce Modelica, an equation-based programming language. Additionally, the course will introduce energy systems at different scales, focusing on the building-scale energy system (HVAC) as well as 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	5th Sep.	1	Introduction	
	7th Sep.	2	Review I - Thermal dynamics	
2	12th Sep.	3	Review II - Heat transfer I	
	14th Sep.	4	Review III - Heat transfer II	H1 released
3	19nd Sep.	5	Room level thermal dynamics	
	21st Sep.	6	Dynamic system modeling I	H1 due
4	26th Sep.	7	Dynamic system modeling II	
	28th Sep.	8	Modelica I – introduction	
5	3rd Oct.	9	Lab1. Solving ODE and PDE	
	5th Oct.	10	HVAC overview	
6	10th Oct.	11	HVAC heat source	
	12th Oct.	12	HVAC heat pump I	H2 released
7	17th Oct.	13	Lab2. Building envelope model	
	19th Oct.	14	Modelica II – OOP	H2 due
8	24th Oct.	15	Lab3. HVAC model	
	26th Oct.	16	HVAC heat pump II	
9	31st Oct.	17	Lab4. Building energy modeling	Project released
	2nd Nov.	18	HVAC distribution system	
10	7th Nov.	19	Pump and fan	
	9th Nov.	20	HVAC terminal	Project due
11	14th Nov.	21	Guest lecture: modeling engineering system with uncertainties I	
	16th Nov.	22	Guest lecture: modeling engineering system with uncertainties II	
12	21st Nov.	23	HVAC control	H3 released
	23rd Nov.	24	District heating and cooling system I	
13	28th Nov	25	District heating and cooling system II	H3 due
	30th Nov	26	Course overview	

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 Tuesday/Thursday night and be due the following Tuesday/Thursday midnight (23:59 pm).

Project

The purpose of this project is to provide you with an opportunity to put your knowledge of building energy system modeling and the Modelica language into practice. It allows you to apply the concepts learned during the lecture and lab sessions. You are required to submit both the Modelica model and a project report before the project deadline.

Assignment/project late policy

All assignments must be turned in on time (deadline is 23:59 pm). We will allow a total of five late days (Weekends and holidays counted) cumulatively, shared by the assignments and projects. The late days are intended to provide for exceptional circumstances, and you are advised not to use them unless absolutely necessary. Any assignments that are submitted late (with insufficient late days remaining) will not be graded.

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.

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/