CIVE 480F – Building and district energy simulation

Term – Spring 2017 (201701)

Instructor: Dr. Ralph Evins
Office Hours: Days: Tuesday
Phone: Time: 11:20 - 12:00
E-mail: Location:

List all prerequisites and co-requisites: CIVE 450 is a prerequisite unless exemption is granted.

DATES

Lectures and computer lab work will be interspersed in all sessions (see below)

<table>
<thead>
<tr>
<th>Days:</th>
<th>Time:</th>
<th>Location:</th>
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<tbody>
<tr>
<td>Tuesdays, Wednesdays &amp; Fridays</td>
<td>10:30 - 11:20</td>
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</table>

TA Name  E-mail  Office

Required Text  Optional Text
None  Title: Building Performance Simulation for Design and Operation
Author: Jan L.M. Hensen (Editor), Roberto Lamberts (Editor)
Publisher/Year: Routledge, 2011

Reference Materials:
COURSE OBJECTIVES

This course teaches the principles of building energy simulation and guides students in the use of such tools for the design of low-energy buildings. This is achieved through a term-long project in which groups of students develop a building design using simulation tools to assist them. This mimics the approach found in engineering practice, where simulation is an essential part of the design process.

Specific simulation tasks include:
- Climate analysis
- Geometric and building envelope design
- Daylight and solar gains, including glazing and shading
- Thermal comfort and building control
- Heating, ventilation and air-conditioning systems
- Air flow and natural ventilation
- Renewable energy and storage technologies
- District-level energy systems
- Parametric analysis and computational design optimisation.

As well as simulation skills, students will gain a better understanding of energy flows in buildings and districts, and of the integrated nature of the building design process. They will also practice working constructively together, budgeting their time appropriately and presenting their findings clearly.

LEARNING OUTCOMES: At the end of this course, students will be able to:

Use simulation tools to predict building energy performance.
Explain the core principles of building energy simulation.
Analyze the outputs of an energy simulation to determine their meaning, and evaluate their accuracy.
Compare building design alternatives using standard and parametric methods.
Identify specific building performance failings using simulation, and design interventions to address them.
Propose and implement a simulation strategy to assess a specific design aspect.
Discuss the limitations of the assumptions that underpin typical simulation tools.
Devise additional modelling steps that may be required to improve upon basic techniques.

<table>
<thead>
<tr>
<th>Weight &amp; Date(s) of Assessments</th>
<th>Weight</th>
<th>Date</th>
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</thead>
<tbody>
<tr>
<td>Course project - report</td>
<td>50%</td>
<td>Friday 31 March 2017</td>
</tr>
<tr>
<td>Course project - presentation</td>
<td>25%</td>
<td>Week of 27-31 March 2017 (TBA)</td>
</tr>
<tr>
<td>Weekly assignments</td>
<td>25%</td>
<td>See below</td>
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</tbody>
</table>

LABORATORIES (Description & Method of Delivery)

All sessions will be conducted in the computer lab. They will consist of short lectures on the principles underlying energy simulation, instruction and demonstration of their implementation using the software, and practical work to be completed by all students. Short weekly computational assignments will be set on Tuesdays for submission by 5pm the following Monday in weeks 1 to 10 (see Course Schedule). The session on Fridays will be largely devoted to completing these assignments, with assistance available from the instructor and TA.

Weekly assignments are to be completed individually. Electronic submission details TBC.
PROJECT: (Description & Method of Delivery)

A term-long project will apply the skills learnt during the course to the design of a low-energy building. The brief specifies the building geometry, basic design and modelling assumptions, but students must determine the glazing and shading, daylighting controls and full HVAC design, including air flow solutions and pollutant control. The objective is to minimise energy use whilst maintaining comfortable indoor conditions. The project mimics the typical role of a building energy simulation specialist in an engineering consultancy.

Projects will be judged on their documented use of building simulation tools to justify design decisions. Most weekly assignments will relate to the final project work. The penultimate two week of term will be devoted to project work, with advice available during class times if desired. Project submission will be in the form of a 20 page report (plus appendices) and associated model files. A report structure will be provided. Additionally, there will be a project presentation of 15 minutes plus 5 minutes of questions.

Students can chose to submit their final reports to the Building Simulation conference student competition; the winner will be invited to present their project at the conference in San Francisco.

The project will be completed in groups of five. Students will be assigned to a group. Each group will submit one report and give one presentation. The contributions of each team member must be clearly stated, and may be used to assign different grades to members of a team. Electronic submission details TBC.

NOTE: Failure to complete all weekly assignments will result in a grade of N being awarded for the course.

The final grade obtained from the above marking scheme for the purpose of GPA calculation will be based on the percentage-to-grade point conversion table as listed in the current Undergraduate Calendar.

COURSE LECTURE NOTES

Unless otherwise noted, all course materials supplied to students in this course have been prepared by the instructor and are intended for use in this course only. These materials are NOT to be re-circulated digitally, whether by email or by uploading or copying to websites, or to others not enrolled in this course. Violation of this policy may in some cases constitute a breach of academic integrity as defined in the UVic Calendar.

There will be no supplemental examination for this course.
GENERAL INFORMATION

Note to Students:
Students who have issues with the conduct of the course should discuss them with the instructor first. If these discussions do not resolve the issue, then students should feel free to contact the Chair of the Department by email or the Chair’s Secretary to set up an appointment.

“Attendance
Students are expected to attend all classes in which they are enrolled. An academic unit may require a student to withdraw from a course if the student is registered in another course that occurs at the same time....

An instructor may refuse a student admission to a lecture, laboratory, online course discussion or learning activity, tutorial or other learning activity set out in the course outline because of lateness, misconduct, inattention or failure to meet the responsibilities of the course set out in the course outline. Students who neglect their academic work may be assigned a final grade of N or debarred from final examinations.

Students who do not attend classes must not assume that they have been dropped from a course by an academic unit or an instructor. Courses that are not formally dropped will be given a failing grade, students may be required to withdraw and will be required to pay the tuition fee for the course.” UVic Calendar, (2016) http://web.uvic.ca/calendar2017-01/FACS/UnIn/UARe/Atte.html

Accommodation of Religious Observance (AC1210)
http://web.uvic.ca/calendar2017-01/GI/GURe.html

Discrimination and Harassment Policy (GV0205)
http://web.uvic.ca/calendar2017-01/GI/GURe.html

Faculty of Engineering, University of Victoria
Standards for Professional Behaviour
“It is the responsibility of all members of the Faculty of Engineering, students, staff and faculty, to adhere to and promote standards of professional behaviour that support an effective learning environment that prepares graduates for careers as professionals....”

You are advised to read the Faculty of Engineering document Standards for Professional Behaviour which contains important information regarding conduct in courses, labs, and in the general use of facilities.
http://www.uvic.ca/engineering/current/undergrad/index.php #section0-23

Cheating, plagiarism and other forms of academic fraud are taken very seriously by both the University and the Department. You should consult the Undergraduate Calendar for the UVic policy on academic integrity.

Policy on Academic Integrity
http://web.uvic.ca/calendar2017-01/FACS/UnIn/UARe/PoAcI.html

Updated August 2016
## Course Schedule

*Topics in italics* are optional advanced material that will not be examined.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
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<tbody>
<tr>
<td>2</td>
<td><strong>Inside and outside boundary conditions.</strong> Internal and external loads. Thermal comfort. Analysis of the climate (strategy selection).</td>
</tr>
<tr>
<td>3</td>
<td><strong>Geometry.</strong> Introduction to the OpenStudio SketchUp plugin. Start on project geometry. <strong>Building envelopes.</strong> Constructions (insulation, thermal mass). Glazing (geometry, transmittance). Shading devices (internal/external, passive/active).</td>
</tr>
<tr>
<td>4</td>
<td><strong>Parametric modelling and optimization.</strong> Use of the OpenStudio parametric module. <em>Advanced parametrics and optimization.</em></td>
</tr>
<tr>
<td>7</td>
<td><strong>Project work.</strong></td>
</tr>
<tr>
<td>8</td>
<td><strong>Project work.</strong></td>
</tr>
<tr>
<td>9</td>
<td><strong>Presentations; Report due.</strong></td>
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</tbody>
</table>

*Updated August 2016*