**ARCH 8685 Building Simulation**

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Office hours by appointment

Class days/time/place –Friday 10 – 12 Hinman Research Building HPB Lab

Requirements: Knowledge of physical transport phenomena in buildings.

Basic knowledge of the functional role and technical aspects of building systems with emphasis on heat and mass transport inside and around buildings.

Intermediate level in calculus and physics assumed

**Learning Objectives**

* Students get familiar with state of the art theories and methods in building simulation research, with emphasis on the current state and future directions in simulation methods, tools and computational methods.
* An advanced understanding of the frontiers in building simulation research is acquired.
* The major objective is to ascertain students’ ability to do independent, creative research in the domain. If the time is right (mostly for 2nd year PhD students) the course assignments may lead to a concept paper for a thesis proposal.

**Synopsis**

The course will closely follow selected chapters from the two textbooks.

The course explores the following topics each supported by a selected chapter:

* introduction and trends in building simulation
* thermal comfort
* lighting simulation
* performance based design and operation
* the role of weather data
* integrated airflow simulation and (hybrid) ventilation aspects
* HVAC systems performance
* integration of simulation in design
* urban energy simulation
* handling of uncertainty
* acoustics

The course will focus on research methods and state of the art in each of these areas and concentrate on: (1) next generation simulation techniques and platforms, (2) fidelity of building energy models, linked with UQ/UA (3) frontiers in interoperability of simulation in building design (4) the simulation of air flows in and around buildings, (5) resolution of simulation model versus resolution of available information

**Readings, Course Assignments and Grading:**

1. Malkawi, Ali and Godfried Augenbroe (eds.). Advanced Building Simulation.Spon Press, 2004
2. Hensen, Jan L.M., and Roberto Lamberts (eds). Building performance simulation for design and operation. Spon Press (2011).

Other material: mostly from [www.ibpsa.org](http://www.ibpsa.org).

A major source is the most recent BS2017 conference in SF, i.e.

* recorded sessions: <https://www.ibpsa.us/news/recorded-sessions-building-simulation-2017-are-now-available> (needs login)
* Downloadable papers <http://www.ibpsa.org/> (not yet available?)

For the 2nd reader: most chapters have a youtube recording of the webinars given by the authors, start here: <https://www.youtube.com/watch?v=NyQgOJ-HaeA>

Each topic will be introduced in class based on assigned reading and assigned youtube viewing followed in class by discussion of the chapter and other ongoing research efforts and PhD theses from around the globe

Each week there will be an individual assignment based on a specific inquiry or hypothesis, or provocative question. At mid and end-term students present in a more extensive treatment of a topic that builds on the material in the textbooks, but extends it to a meaningful plan of new research (a mini-proposal). Students can come with their own ideas to be vetted by the instructor. The mini proposal should have an overview of current research, a new challenge, a research approach and expected results. The final assignment will require students to write a larger research proposal which pushes the envelope of current building simulation research in an assigned area.

All assignments must be done individually, no teamwork.

Some mid and final papers will be selected for presentation in our BT seminar in conference style

Grading will be based on term discussion papers, presentations and final assignment.

* Weekly discussion papers (1-2 pages) 25% (A1-A6)
* Midterm paper (5-10 pages) 25% (MT)
* Final paper (10+ pages) 40% (Final)
* Conference style presentation (ppt) 10%
* Course readings and other materials will be distributed through T-square. All communication will be sent via T-square, so be certain that you check the email address that T-Square uses.
* Homework assignments must be submitted on time. I expect homework submissions to be well organized. Written assignments must be typed. All homework assignments that rely on outside sources should cite those sources. Homework assignments will be uploaded to t-square

**Academic Integrity:**

Academic dishonesty will not be tolerated. This includes cheating, lying about course matters, plagiarism, or helping others commit a violation of the Honor Code. Some exams (when specifically announced in class) allow the use of self-prepared supporting information (one sheet of paper, either typed or handwritten, could be double-sided); no other support materials are allowed at tests. Plagiarism includes reproducing the words of others without both the use of quotation marks and citation. Students are reminded of the obligations and expectations associated with the Georgia Tech Academic Honor Code and Student Code of Conduct, available online at www.honor.gatech.edu.

**Learning Accommodations**:

If needed, we will make classroom accommodations for students with documented disabilities. These accommodations must be arranged in advance and in accordance with the Office of Disability Services (<http://disabilityservices.gatech.edu>).

Lecture Schedule: Every week a chapter from the textbooks will be treated.

Special Considerations: This course is a measure and self-assessment of how well students are equipped to become a scholar in the field. You have to score at least a high B in the class to be able to become a successful researcher in the PhD program.

**Weekly Schedule:**

Week 1 (8/25): Introduction R1-Ch1; R2-Ch1 (A1)

Week 2+3 (9/1+9/8): Uncertainty Analysis: R1-Ch2+Ch3; R2-Ch3 (A2)

Week 4+5 (9/15+9/22): Flow simulation: R1-Ch4+Ch5; R2-Ch6 (A3)

Week 6+7 (9/29+10/06): BIM-BEM interoperability: R1-Ch8; R2-Ch17 (A4)

Week 8+9 (10/13+10/20): Midterm paper: mini research proposal (MT)

Week 10+11 (10/27+11/03): Occupants and performance R2-Ch4+7+15 (A5)

Week 12+13 (11/10+ 11/17): Optimization and control: R2-Ch13+14 (A6)

Week 14 (NO CLASS) + 15 +16: Final paper: concept thesis proposal (Final)