PRGR 645: Building Energy Systems Modeling (2 cr.)

Catalog Description: PRGR 645: Building Energy Systems Modeling
Credits: **2**
A course that covers indoor space thermal models. The course also deals with the analysis and modeling of building energy systems involving applications of thermodynamics, economics, heat transfer, fluid flow, and optimization. The use of modern computational tools to model thermal performance characteristics of components of HVAC systems including chillers, recovery systems, flow control devices, heat exchangers, solar panels, dehumidification systems, boilers, condensers, cooling towers, fans, duct systems, piping systems and pumps.

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Textbook

There are no required textbooks for this class. A textbook that you might find useful is: Energy Simulation in Building Design, J A Clarke, 2002, 2nd edition.

References

1. *2001 ASHRAE Handbook*: *Fundamentals*, IP or SI edition, hard copy or CD
2. *Numerical Heat Transfer and Fluid Flow*, S V Patankar, 1980
3. *Solar Engineering of Thermal Processes*, John A. Duffie, William A. Beckman, 1991
4. *Design of Thermal Systems*, W. F. Stoecker, 1998

Course Learning Outcomes:\

By the end of the course, students will be able to:
1. Identify basic building elements which affect building energy consumption and analyze the performance of these elements using energy conservation models.
2. Analyze the physics behind various numerical tools used for solving different heat transfer problems in building elements.
3. Use basic numerical methods for solving systems of linear and nonlinear equations.
4. Conduct building energy and mass transfer analysis using comprehensive computer simulation tools.
5. Evaluate the performance of building envelope and environmental systems considering energy consumption in buildings.
6. Perform parametric analysis to evaluate the effects of design choices and operational strategies of building systems on building energy use.
7. Use energy simulations in life-cycle cost analyses for selection of energy-efficient building components.

Topics:

1. Course Introduction and Background
2. Fundamentals of energy and mass transfer
3. Thermal analysis of building components
4. Numerical methods
5. Energy simulation tools
6. Introduction to DOE2 (eQUEST) software
7. Building envelope analyses
8. HVAC System analyses

Assessment

Mid-term	x1%
Classroom Participation	x2%
Homework Assignments	x3%
Midterm Project	x4%
Final Project & Presentation	x5%
Total	100%

Resources

References; instructor; Lectures on moodle; class notes and handouts; Library; Web.

Computer Usage

Basic knowledge of any programming language (Fortran, C, Matlab, etc.) or use of equation solver tools (MathCAD, Mathematica, EES, etc.) is beneficial. Some homework assignments and the term projects will require extensive use of computers. The students will use the energy simulation software eQUEST and other energy simulation tools for projects and homework assignments.