CE 311: Architectural Engineering
Fall 2016

Lectures: T, TH: 12:00-13:15 - HAMP 3153

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Prerequisites: ME 200: Thermodynamics or permission from the instructor.
Concurrent Prerequisites: CE 340: Hydraulics or ME: 309 Fluid Mechanics or permission from the instructor.

Textbook - Required
Karava, P. and Qu, M. (2011). *Architectural Engineering.* McGraw Hill, Custom-Made Book, ISBN-13:9781121421493.

Additional References
Bergman, T.L., Lavine, A.S., Incropera, F.P., and DeWitt, D.P. (2011). *Fundamentals of Heat and Mass Transfer*, 7th Edition. Wiley.

Grondzik, W.T., Kwok, A.G., Stein, B., and Reynolds, J.S. (2010). *Mechanical and Electrical Equipment for Buildings*, 11th Edition. Wiley. [Online access available through Purdue Libraries].

Kuehn, T.H., Ramsey, J.W., Threlkeld, J.L. (1998). *Thermal Environmental Engineering*, 3rd Edition. Pearson.

McQuiston, F.C., Parker, J.D., and Spitler, J.D. (2005). *Heating, Ventilating, and Air Conditioning: Analysis and Design*, 6th Edition. Wiley.

Course Objectives
The objective of this course is to introduce the engineering fundamentals required for the design and analysis of building environmental systems such as thermodynamics and psychrometrics, fluid mechanics, heat transfer, and mass transfer. The course also presents engineering principles and selected applications related to hygrothermal analysis of building enclosures, air conditioning processes, ventilation, and indoor air quality.

Course Outcomes
Upon completion of this course, the students will be able to:
- Identify and analyze the characteristics of building environmental loads, building construction, and building operations as they define the requirements for a comfortable and healthy indoor environment.

- Demonstrate knowledge of thermodynamics, fluid mechanics, and heat and mass transfer for use in building design.
- Identify, formulate, and solve realistic Architectural Engineering problems related to hygrothermal analysis of building enclosures, air conditioning processes, and pipe and duct flow.
- Demonstrate an understanding of building systems integration to achieve efficient operation.

The learning process includes:
- Reading: The text is a comprehensive source of information on fundamental topics such as thermodynamics, fluid mechanics, and heat and mass transfer.
- Lectures: Lectures notes and handouts (posted on blackboard) are important sources of information on topics such as building enclosures and heating, ventilation, and air conditioning (HVAC) systems.
- Homework: Exercises are designed to reinforce the concepts presented during lectures. Students shall become familiar with analytical and computational methods for quantifying building performance.

Grading
The overall course grade will be weighted as follows:
Homework Assignments: 20%
Mid-Term Exams (2): 40%
Final Exam: 25%
Project: 10%
Participation: 5%

The plus/minus grading system will be used (e.g. 96.7% and up = A+; 93.3% to 96.7% = A; 90.0% to 93.3% = A-; 86.7% to 90.0% = B+; 83.3% to 86.7% = B; 80.0% to 83.3% = B-).

Attendance
Regular attendance and participation are essential and expected. If you are unable to attend a lecture due to illness, personal or family emergency, or observance of a holiday, please contact me via e-mail. Cell phone use during lecture is prohibited.

Homework Assignments
Homework will be assigned regularly (approximately seven assignments in total). Assignments should be done neatly and submitted with final solutions clearly summarized and marked. Assignments are to be turned in at the beginning of the lecture on the date due. Late assignments will not be accepted unless a specific arrangement has been made with the instructor at least a day prior to the due date. Put your name, date due, problem number on everything you hand in.

Mid-Term & Final Exams
There will be two mid-term exams. The details of these exams will be announced. No make-ups will be allowed unless arrangements have been made at least one week prior to the scheduled time. Make-up exams will be given only in the event of a verified emergency or doctor-verified sickness. Time and location of the final exam will be announced.

Course Project
There will be a small group project on building performance assessment (e.g. energy simulation, hygrothermal analysis). Details on the topics and expectations will be provided during the semester.

Academic Dishonesty
Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty" [Part 5, Section III-B-2-a, University Regulations]. Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest" [University Senate Document 72-18, December 15, 1972].

Grief Absence Policy for Students
Purdue University recognizes that a time of bereavement is very difficult for a student. The University therefore provides the following rights to students facing the loss of a family member through the Grief Absence Policy for Students (GAPS). GAPS Policy: Students will be excused for funeral leave and given the opportunity to earn equivalent credit and to demonstrate evidence of meeting the learning outcomes for missing assignments or assessments in the event of the death of a member of the student's family.

Students with Disabilities
If you have a disability that requires special academic accommodation, please make an appointment to speak with me during the first week of the semester in order to discuss any adjustments. It is the student's responsibility to notify the Disability Resource Center `http://www.purdue.edu/drc` of an impairment/condition that may require accommodations and/or classroom modifications.

Emergencies
In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted on Blackboard or can be obtained by contacting me via e-mail.

Nondiscrimination
Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.

Purdue University prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, genetic information, marital status, parental status, sexual orientation, gender identity and expression, disability, or status as a veteran. The University will conduct its programs, services and activities consistent with applicable

federal, state and local laws, regulations and orders and in conformance with the procedures and limitations as set forth in Executive Memorandum No. D-1, which provides specific contractual rights and remedies. Any student who believes they have been discriminated against may visit `http://www.purdue.edu/report-hate` to submit a complaint to the Office of Institutional Equity. Information may be reported anonymously.

Tentative Course Outline [*Updated: August 22, 2016*]

Lectures	**Days**	**Topics Covered**
1-2	Aug. 23, 25	**Course Introduction**: introduction to building environmental systems.
3-8	Aug. 30, Sept. 1, 6, 8, 13, 15	**Thermodynamics & Psychrometrics**: thermodynamic properties of air, ideal gas law, gas-vapor mixtures, water vapor, dry and atmospheric air, psychrometric properties, psychrometric processes, psychrometric chart, human comfort and air conditioning, principles of the conservation of mass and energy to various air conditioning processes.
9-10	Sept. 20, 22	**Fluid Mechanics**: fluid properties, fluid flow through pipes and ducts, fluid friction, Moody diagram, pressure drop and head loss calculation, parallel flow over flat plates.
11-18	Sept. 27, 29, Oct. 4, 6, 13, 25, 27, Nov. 1	**Heat Transfer**: mechanisms of heat transfer, thermal conductivity, steady state heat conduction in plane walls, thermal resistance, physical mechanisms of forced convection, thermal boundary layer, forced convection over flat plates and inside pipes, natural convection over surfaces, natural convection inside enclosures, electromagnetic spectrum and thermal radiation, blackbody radiation, radiative properties of materials, view factors, radiation heat transfer.
Oct. 10-11: October Break		
Oct. 17-21: Conference Travel - Guest Lectures		
19-21	Nov. 3, 8, 10	**Mass Transfer**: diffusion mass transport, mass diffusivity.
22-25	Nov. 15, 17, 22, 29	**Hygrothermal Analysis of Buildings**: heat flow and thermal gradients in simple wall assemblies, solar geometry, windows, vapor permeance, one-dimensional steady state vapor flow in wall assemblies, interstitial condensation (occurrence and quantity), moisture control.
Nov. 23-26: Thanksgiving Vacation		
26-28	Dec. 1, 6, 8	**Heating, Ventilation, and Air Conditioning (HVAC) Systems**: types of HVAC systems, Air Handling Units (AHUs), HVAC distribution components, principles and calculation methods for simple variable-air-volume (VAV) systems, introduction to HVAC systems commissioning through practical examples, introduction to indoor air quality, and filtration.

Note: This syllabus is subject to change. Current version: August 22, 2016.