Welcome to MEEG 5873
Indoor Environmental Design
(aka HVAC Design and Analysis)

University of Arkansas
MSE – Distance Education

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Course Description: This course is a broad use of thermal-fluid concepts toward understanding and applying fundamental theories of heating, ventilating, and air conditioning (HVAC) design. Upon completion of the course, students will be able to apply current engineering techniques and methodologies to design HVAC systems, including heating and cooling loads, and proper selection and sizing of air conditioning equipment. Moreover, through this class, students will gain a physical understanding of HVAC systems and buildings, which is needed for today's HVAC designs. This course may be of interest to engineers in industry, consulting, facilities, and others.

Text: Howell, R., *Principles of Heating, Ventilating, and Air Conditioning*, ASHRAE, 8th edition

Required Prerequisite: MEEG 4413 or consent of instructor.

Office Hours: email preferred or phone/virtual video call by appointment.

Academic Honesty:
As a core part of its mission, the University of Arkansas provides students with the opportunity to further their educational goals through programs of study and research in an environment that promotes freedom of inquiry and academic responsibility. Accomplishing this mission is only possible when intellectual honesty and individual integrity prevail. I, as your instructor, am committed to the principle of academic honesty and I expect each student in my class to maintain a high stand of academic integrity. To that end, you are required to be familiar with and abide by the University's 'Academic Integrity Policy' which may be found at http://honesty.uark.edu/policy. Students with questions about how these policies apply to a particular course or assignment should immediately contact Dr. Nutter.

Grades: (final grading scale based on 90/80/70/60…)

	GRADE PERCENTAGE
Homework, Quizzes, and In-class problems	20%
Design project and/or report	10%
Two hourly exams	50%
Final exam (comprehensive)	20%

Homework, Quizzes, and In-class problems: 'Homework' assignments will consist of traditional out-of-class assignments via BlackBoard and BlackBoard quizzes. Collaboration on out-of-class homework, except on Blackboard quizzes, is encouraged, but is should be declared. Assignments will be posted on the Blackboard (http://learn.uark.edu) website. Disorganized or messy homework will be penalized. Due dates/times will be posted with each assignment. Also, in an effort to accommodate for unexpected events, the lowest single homework score will be dropped, no matter the reason.

Exams: Exams will follow MSE policies and procedures.

Course objectives – by the end of this or course, students will be able to:

1. define and recognize key concepts associated with HVAC systems [Reading – text Chapter 1 and instructor supplemental]
   1.1. Definition of HVAC
   1.2. Significance of HVAC industry
   1.3. Engineer's roles in HVAC system design, analysis, and consulting
   1.4. History of HVAC history
   1.5. Factors associated HVAC systems
2. understand modern design techniques and methods [Reading – text Chapter 1 and instructor supplemental]
   2.1. Traditional engineering design process of HVAC systems
   2.2. Green building design and rating systems (LEED and Green Globes)
   2.3. ASHRAE, the international HVAC professional society
3. analyze air-conditioning and heat pump system configurations [Reading – text Chapter 2]
   3.1. Ideal refrigeration cycle
   3.2. Pressure-enthalpy diagram
   3.3. Standard HVAC&R system performance factors
4. identify and apply the key engineering units and calculations of psychrometrics [Reading – text Chapter 2 and Chapter 3]
   4.1. Thermodynamic basics and properties
   4.2. Psychrometric chart
   4.3. Individual classic moist air processes
   4.4. Whole system-level
5. apply standards for internal, external, and energy design conditions [Reading – text Chapter 4]
   5.1. ASHRAE/ANSI standard 62.1 – Ventilation for acceptable indoor air quality
   5.2. ASHRAE/ANSI standard 55 – Thermal environmental conditions for human occupancy
   5.3. ASHRAE/ANSI standard 90.1 – Energy standard for buildings except low-rise residential buildings
6. evaluate load estimating fundamentals for various designs [Reading – text Chapter 4 and 5]
   6.1. infiltration
   6.2. Overall heat transfer coefficients
   6.3. Temperature in adjacent unheated spaces
   6.4. Inner surface temperatures subject to condensation
7. determine heating system load estimates [Reading – text Chapter 7]
   7.1. Manual heating load procedure
   7.2. Zoning and coincidental peak
   7.3. Special allowance consideration, including start-up
   7.4. Supply air volumetric air flow rates
8. determine cooling system load estimates [Reading – text Chapter 7]
   8.1. Heat balance method for cooling
   8.2. Solar heat gain through fenestrations

8.3. Internal heat gain from people, equipment, and lights
8.4. Zoning and coincidental peak
8.5. Supply air volumetric air flow rates

9. determine duct sizing [Reading – text Chapter 9]
   9.1. Pressure changes during flow in ducts
   9.2. Friction and dynamic losses
   9.3. Equivalent duct sizing
   9.4. Design velocities
   9.5. Critical path
   9.6. Duct design method(s)
10. apply basic building modeling [Reading – instructor supplemental]
   10.1. Energy simulation
   10.2. Building information modeling (BIM)
11. create and evaluate an HVAC system design [Reading – n/a]
   11.1. Application of topics above
   11.2. Custom project per student

Definition of <u>air-conditioning:</u>

The process of treating air to control simultaneously its <u>temperature, humidity, cleanliness, and distribution</u> as required by occupants, a process, or a product in a space.

By Willis Carrier

Additional requirements due to remote delivery and course continuity.

In the event of an extended campus closure, the continuity plan for this course includes the following:

- We will continue to utilize our Blackboard course as the portal for the delivery of course materials and UARK email for communications. Please check both of these areas immediately for guidance and directions from me;
- We will utilize Zoom to connect as a class during our regularly scheduled class days/times;
- I will utilize Zoom or Teams to connect with students during my regularly scheduled office hours and by appointment.

This course will use Zoom for synchronous ("real time") class meetings. Meeting dates and times will be during regular class time, as noted above. Please take the time to familiarize yourself with Zoom by visiting https://uark.zoom.us/. You may choose to use Zoom on your mobile device (phone or tablet), but be prepared to have frequent Blackboard quizzes during class periods.

Things to Know About Using Zoom for Class Meetings:

- You must sign in to the Zoom session by 3:00 PM to be on time for class.
- The Zoom sessions are recorded.
- Improper classroom behavior is not tolerated within Zoom sessions and may result in a referral to the Office of Student Conduct.
- You can contact the Help Desk at http://help.uark.edu or 479-575-2905 if you have any technical issues accessing Zoom.

Assessments
Respondus LockDown Browser and Respondus Monitor is a test monitoring system used by the University of Arkansas that utilizes a webcam to monitor test-taking activity during online/remote testing. We may be using this test proctoring system for exams in this course. It is your responsibility to ensure that you will have access to a computer with internet connection and a webcam and know how to log into and use Respondus LockDown Browser and Respondus Monitor prior to the time that the tests start. If you do not have a webcam, you can visit the Student Technology Center to check one out. Currently, Respondus LockDown Browser and Respondus Monitor are not compatible with Chromebooks. If an issue occurs during a test, finish the test and contact me via dnutter@uark.edu. Test your webcam before the test. For assistance with setup, contact the Help *Desk at* help.uark.edu *or 479-575-2905.*

Class recording
Instructors may record class and make class available to students through Blackboard. These recordings may be used by students ONLY for the purposes of the class. Students may not download, store, copy, alter, post, share, or distribute in any manner all or any portion of the class recording, e.g. a 5-second clip of a class recording sent as a private message to one person is a violation of this provision. This provision may protect the following interests (as well as other interests not listed): faculty and university copyright; FERPA rights; and other privacy interests protected under state and/or federal law. Failure to comply with this provision will result in a referral to the Office of Student Standards and Conduct for potential charges under the Code of Student Life. In situations where the recordings are used to gain an academic advantage, it may also be considered a violation of the University of Arkansas' academic integrity policy.

Unauthorized Recording by Student

Recording, or transmission of a recording, of all or any portion of a class is prohibited unless the recording is necessary for educational accommodation as expressly authorized and documented through the Center for Educational Access with proper advance notice to the instructor. Unauthorized recordings may violate federal law, state law, and university policies. Student-made recordings are subject to the same restrictions as instructor-made recordings. Failure to comply with this provision will result in a referral to the Office of Student Standards and Conduct for potential charges under the Code of Student Life. In situations where the recordings are used to gain an academic advantage, it may also be considered a violation of the University of Arkansas' academic integrity policy.

Recording of Class Lectures

By attending this class, student understands the course is being recorded and consents to being recorded for official university educational purposes. Be aware that incidental recording may also occur before and after official class times.