Advanced Controlled Environment Agriculture Systems Design

ABE5310
Credits: 3
Class Periods: MWF, 3rd period, from 9:35 AM to 10:25 AM
Location: 283 Frazier Rogers Hall
Academic Term: Spring 2026

Instructor

Ying Zhang
Email Address: yingzhang409@ufl.edu
Office Phone: (352)294-6864
Office Hours: MW 7th & 8th periods, from 1:55 pm to 3:50 pm, Frazier Rogers Hall room 103
When contacting the instructor, please allow up to 48 hours for a response, not including weekends or holidays.

Course Description

An introduction to the engineering design of controlled environment agriculture systems, including glazing materials selection, fan sizing for mechanical ventilation, lighting distribution, cooling system design with fan-and-pad evaporative cooling, and heating system design with hot water floor heating.

Course Pre-Requisites / Co-Requisites

MAC1147 Precalculus Algebra and Trigonometry and 3 credits of physics

Course Objectives

This is an elective course. Students, upon completing this course, will be able to:

a. Describe environmental factors that affect plant growth and development under controlled environment
b. Explain how agricultural structures affect the energy balance of controlled environment systems
c. Apply the principles of HVAC design and analysis for equipment selection, system sizing and system design.
d. Identify and quantify system elements in the design of controlled environment systems
e. Design a controlled environment system to meet desired needs within realistic constraints.

Materials and Supply Fees

Not Applicable

Required Textbooks and Software

Handouts and online material will be provided to students.

Recommended Materials

- Greenhouse Operation and Management
- Paul V. Nelson
- 2011, 7th Edition
- ISBN number: 978-0132439367

Course Schedule

Week 1: Overview of controlled environment agriculture systems and SI units/**Reading Assignment 1**
Week 2: Plant responses to environmental factors/**Quiz 1/ Reading Assignment 2**
Week 3: Psychrometrics/**Homework 1/ Reading Assignment 3**
Week 4: Design of structures/**Quiz 2/ Reading Assignment 4**
Week 5: Shading and solar radiation/**Homework 2/ Reading Assignment 5**
Week 6: Irrigation and fertigation systems/**Quiz 3/ Reading Assignment 6**
Week 7: Heating systems/**Homework 3/ Reading Assignment 7**

Week 8: Review/ Greenhouse tours/**Exam 1/ Reading Assignment 7**
Week 9: Cooling and ventilation/**Homework 4/ Reading Assignment 8**
Week 10: Root substrate/**Quiz 4/ Reading Assignment 9**
Week 11: Lighting designs and CO_2 enrichment/**Homework 5/ Reading Assignment 10**
Week 12: Pest management and insect screens/**Quiz 5/ Reading Assignment 11**
Week 13: Sensing and climate control/**Homework 6/ Reading Assignment 12**
Week 14: Postharvest and food security/ **Quiz 6/ Reading Assignment 13**
Week 15: Renewable energy applications/Review
Finals Week: **Exam 2 & Term Project Report**

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance. Attendance. Attendance (on time) at lectures is expected from all students at all times and will be recorded at every class meeting. Excused absences must be consistent with university policies in the Undergraduate Catalog (https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/#absencestext) and require appropriate documentation. Additional information, including religious holidays, illness policy, and twelve-day rule can be found here: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx.

Late Submission of Course Work. All course work (including, but not limited to: assignments, quizzes, exams, and term projects) must be submitted no later than the due date unless prior arrangements are made with the instructor and a new due date is established. Assignments submitted late without having made arrangements with the instructor, but before 5:00 PM on the day following the due date, will be marked down 10 points. Assignments returned late, before 5:00 PM on the second day following the due date will be marked down 50 points. Students with documented evidence of an excused absence that prevented prior communication with the instructor may present documentation to the instructor for consideration.

Make-up Exams. No make-up exams will be given except for valid excused absences explained in Attendance or unless prior arrangements have been made.

In-Class Recording. Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

Online Course Recording. Our class sessions will be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or

utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Evaluation of Grades

Both undergraduate and graduate levels are included in this class. In addition to the assignments of attendance, homework sets, quizzes, two exams, graduate students are required to complete a solo project where they design and size system components in a greenhouse, plant factory, or other facility that produces crops in a controlled environment. The scheme of grades evaluation for the graduate level is as follows:

Assignment	***Total Points***	***Percentage of Final Grade***
Attendance	3 each	10%
Homework Sets (6)	100 each	15%
Quizzes (6)	100 each	15%
Exam1	100	20%
Exam 2	100	20%
Term Project	100	20%
		100%

Attendance (100 pts. each). Attendance (on time) at lectures is expected from all students at all times and will be recorded at every class meeting with a sign-in sheet. The attendance score for each student will be calculated according to the missed percentage of the class meetings without excused absences. Attendance will be weighted at 10% for the final course grade.

Homework Assignments (100 pts. each). Each homework assignment will be worth 100 points and there will be six homework assignments during the semester. **Homework assignments will become available on Friday at 12:00 PM, and they will be due next Friday at 11:59 pm.** Each student must work individually. For the final course grade, homework assignments will be weighted at 15%.

Quizzes (100 pts. each). Each quiz will be worth 100 points and there will be six quizzes during the semester. **Quizzes will become available on Friday at 12:00 PM, and they will be due next Friday at 11:59 pm.** Each quiz will be timed to 120 minutes, and it can only be taken once. Each quiz will consist of a mix of multiple-choice, true false, as well as short, open-ended, essay-style questions. Students can refer to personal notes, websites, or any reference materials to complete the quiz. However, each student must work individually. For the final course grade, quizzes will be weighted at 15%.

Exams (100 pts. each). In exams, students will be asked to analyze different production systems using engineering principles. Each exam will consist of a mix of multiple-choice, short-answer, and computational questions. For the final course grade, each exam will be weighted at 20%.

Term Project (100 pts. total). Graduate students are required to complete a solo project where they design and size system components in a greenhouse, plant factory, or other facility that produces crops in a controlled environment. The design elements include structure design analysis, location of utilities, HVAC system design, lighting design, and operation strategies. For the final course grade, the term project will be weighted 20%. The project report will be graded using the following rubric:

Total	Category	20-25	10-19	5-9	0-4
25	Creativity	Exceptionally clever and unique in showing deep understanding	Thoughtfully and uniquely presented	A few original touches enhance the project	Shows little creativity, originality and/or effort
25	Understanding of Content	Shows a sophisticated understanding of the themes in the course content	Shows an understanding of the major themes of the course content	Displays a somewhat limited understanding of the course content	Does not show an understanding of the course content
25	Grammar	No grammatical or mechanical mistakes in the project	A few grammatical/mechanical mistakes which are not distracting	Several grammatical/mechanic al mistakes which are distracting	Many grammatical/mechanical mistakes throughout the project
25	Overall quality and completion	Project is engagingly organized and presents material that meet the assignment requirements	Project is somewhat organized, complete the basic requirements	Project is disorganized and incomplete	Project is incomplete and not easy to follow

Grading Policy

Percent	***Grade***	***Grade Points***
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 – 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 – 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67

Percent	*Grade*	*Grade Points*
0 - 59.9	E	0.00

Academic Policies & Resources
To support consistent and accessible communication of university-wide student resources, instructors must include this link to academic policies and campus resources: https://go.ufl.edu/syllabuspolicies. Instructor-specific guidelines for courses must accommodate these policies.

Commitment to a Positive Learning Environment
The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values.

If you feel like your performance in class is being impacted, please contact your instructor or any of the following:
- Your academic advisor or Undergraduate Coordinator
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu