Controlled Environment Agriculture Systems Design
ABE4320
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
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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.

Contribution of course to meeting the professional component for ABET

Contributes 3 credit hours toward meeting the minimum 48 credit hours of Engineering Topics in the basic-level curriculum for the Bachelor of Science Degree in Biological Engineering.

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (High)
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors (Low)
3. An ability to communicate effectively with a range of audiences (Low)
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts (High)

5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives (Medium)
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions (High)
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies (Medium)

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**

Attendance Policy, Class Expectations, and Make-Up Policy

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 Graduate Catalog (http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance) and require appropriate documentation. Additional information 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 mentor and a new due date is established. Assignments submitted late without having made arrangements with the mentor, 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 emergency that prevented prior communication with the mentor may present documentation to the mentor 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.

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 undergraduate level is as follows:

Assignment	***Total Points***	***Percentage of Final Grade***
Attendance	3 each	10%
Homework Sets (6)	100 each	20%
Quizzes (6)	100 each	20%
Exam 1	100	25%
Exam 2	100	25%
		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 20%.

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 20%.

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 25%.

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

Percent	*Grade*	*Grade Points*
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
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