

Controlled Environment Production Systems Design

ABE4932 & 6933

Credits: 3

Class Periods: MWF, 2nd period, from 8:30 AM to 9:20 AM

Location: 211 Frazier Rogers Hall or Zoom meetings

Academic Term: Spring 2022

Instructor

Ying Zhang

Email Address: yingzhang409@ufl.edu

Office Phone: (352)294-6864

Office Hours: By Appointment, 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

3 credits & offered each spring: This course provides a concentrated study of design criteria, analysis techniques, and new technologies for plant production under controlled environments. Classes focus on various controlled environment systems, including high tunnels, greenhouses, and vertical farming systems. Students will learn technical skills of controlled environment systems, understand how agricultural structures and system components affect plant growing environment, and how to select materials and equipment to design a controlled environment agriculture system. Students will develop technical skills for energy-conscious designs of heating, ventilation, and air conditioning (HVAC) for load calculation, equipment selection, and system design and evaluation. Operation and management techniques including CO₂ enrichment, irrigation and fertigation, and sensing and control are introduced to students in the course.

Course Pre-Requisites / Co-Requisites

MAC1147 Precalculus Algebra and Trigonometry and 3 credits of physics

Course Objectives

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 you that will serve as a text.

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

Week 2:	Plant responses to environmental factors/Quiz
Week 3:	Psychrometrics/Homework
Week 4:	Design of structures/Quiz
Week 5:	Shading and solar radiation/Homework
Week 6:	Irrigation and fertigation systems/Quiz
Week 7:	Heating systems/Homework
Week 8:	Review/ Exam 1
Week 9:	Cooling and ventilation/Homework
Week 10:	Root substrate/Quiz
Week 11:	Lighting designs and CO ₂ enrichment/Homework
Week 12:	Pest management and insect screens/Quiz
Week 13:	Sensing and climate control/Quiz
Week 14:	Postharvest and food security/ Quiz
Week 15:	Renewable energy applications/Review
Week 16:	Exam 2

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance. Attendance (on time) at lectures is expected from all students at all times. In general, acceptable reasons for absence from or failure to participate in class include illness, serious family emergencies, special curricular requirements (e.g., judging trips, field trips, professional conferences), military obligation, severe weather conditions, religious holidays, and participation in official university activities such as music performances, athletic competition or debate. Absences from class for court-imposed legal obligations (e.g., jury duty or subpoena) must be excused. Other reasons also may be approved.

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. No assignments will be accepted after 5:00 PM on the third day following the due date. Students with documented evidence of an emergency which 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 medical reasons or unless prior arrangements have been made.

Excused Absences. In the event you do miss course work for valid medical reasons, your instructors require letter-head documentation from either a physician (NOT health clinic), an academic advisor, or the UF Dean of Student's Office (UF email will suffice) within 24 hours of an assignment deadline. Please note that letterhead documentation does NOT mean a note from your Mom (or Dad or Aunt, Uncle, cousin, Uncle who is a lawyer, best friend, boss, etc.). Letterhead documentation does NOT refer to a note scribbled on a prescription pad from a walk-in clinic or the Student Health Center the day an assignment is due because you had a cold, or pleading that you overslept, had computer problems, or a job interview on a due date...these types of excuses do not satisfy the criteria for extenuating circumstances and cannot be accepted. Letterhead documentation DOES mean the submission of a formal, business letter on letterhead (or a UF email from advisor or UF Dean of Students) including relevant dates for the excuse within 24 hours of a missed assignment. 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>

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

Undergraduate students:

<i>Assignment</i>	<i>Total Points</i>	<i>Percentage of Final Grade</i>
Homework Sets (6)	100 each	25%
Quizzes (5)	100 each	25%
Midterm Exam	100	25%
Final Exam	100	25%
		100%

Graduate students:

<i>Assignment</i>	<i>Total Points</i>	<i>Percentage of Final Grade</i>
Homework Sets (6)	100 each	20%
Quizzes (5)	100 each	20%
Midterm Exam	100	20%
Final Exam	100	20%
Term Project	100	20%
		100%

Homework Assignments (100 pts. each). Each homework assignment will be worth 100 points and there will be 6 homework assignments during the semester. **Homework assignments will become available on Wednesday at 12:00 PM, and they will be due next Wednesday at 11:59 pm.** Each student must work individually. Make up quizzes will be provided in accordance with the policy described below. For the final course grade, homework assignments will be weighted at 15% for graduate students.

Quizzes (100 pts. each). Each quiz will be worth 100 points and there will be 5 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 60 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. Make up quizzes will be provided in accordance with the policy described below. For the final course grade, quizzes will be weighted at 15% for graduate students.

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% for graduate students.

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 graduate student review article will be weighted 20%.

Grading Policy

The following is given as an example only.

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
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://gatorevals.aa.ufl.edu/>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://gatorevals.aa.ufl.edu/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.