Spring 2014

PLS ABE 475A/ 575A Physiology of Plant Production under Controlled Environment (3 units)

Section 001—Traditional In-class
Section 002—Online
Section 910—Outreach College

Course Description
Students will learn the major environmental factors affecting plant growth and development and will understand interactions between plants and their microenvironments, including light penetration and CO₂/H₂O diffusion. Students will learn energy and mass balance of leaves and canopy and correlate these phenomena with plant productivity and related plant physiological mechanisms. Lectures cover critical controlled environment issues and practices of plant production in greenhouse, plant production factory, tissue culture vessels and post-harvest storage, with an introduction to the current research status in these areas. This course is also available as online course for off-campus students.

Note for Online Course Option
This course is also available as online course for off-campus students and distance education course students (distance education through UA Outreach College: http://www.ceao.arizona.edu/). On campus students are recommended to take traditional in-class section.

Course Prerequisites: Undergraduate plant biology and physiology introduction course or consult with instructor.

In-class Location and Times [for Section 001]:
Monday: 4:15 pm - 5:30 pm (CEAC lecture room)
Wednesday: 4:15 pm - 5:30 pm  (CEAC lecture room)
(CEAC: www.ag.arizona.edu/ceac)

Instructor: Chieri Kubota
Office: Forbes 209/CEAC 102
Phone: 626-8833 (CEAC), email: ckubota@email.arizona.edu
Office Hours: Anytime

Course Objectives:
The course will be offered with the following goals:

I. Students will gain a general overview of plant responses to environmental conditions and will be able to discuss the potential plant responses occurring under controlled environment

II. Students will become familiar with the terminology and techniques of controlled environment agriculture

III. Students will be able to understand specific plant physiology observed under controlled environment.
IV. Students will gain a sufficient understanding of the basics of energy and mass transfer to understand the plant-environment interactions occurring under controlled environment.

V. Graduate students will become familiar with current research and will be able to discuss the nature of future research needed to further develop controlled environment agriculture.

**Textbook (optional):**

There is no required textbook for this class. The following books are recommended as references but are not required.


**Examinations:**

There will be a midterm examination and a final examination.

**Course Topics:**

1. Introduction
   - Overview of controlled environment agriculture
   - S.I. unit
2. Overview of plant responses to environmental conditions
   - Light
   - Gas
   - Air current
   - Temperature
   - Nutrient and irrigation
   - Water and vapor
   - Media (substrate)
3. Canopy and microenvironment
   - Energy balance of leaf and canopy
   - Intracanopy microenvironment
4. Translocation of photosynthates
5. Plant growth analysis
6. Plant water relation
7. Respiration
   - Dark respiration and photorespiration
   - Maintenance and growth respiration
8. Environment control systems and plant growth
   - Greenhouses
   - Hydroponics
   - Postharvest storages
   - Growth chambers
   - Tissue culture systems

**Grading Policy:**

Grade for the course will be based on points accumulated over the course of the semester (541-600 pts. = A; 481-540 pts. = B; 421-480 pts. = C; 361-420 pts. = D; 360
or below = E). Total possible points obtained are 600 pts. These points will be awarded based on attendance, two exams (midterm and final) and homework assignments. A research paper will be assigned to graduate students and will be added to the points for graduate students.

For undergraduate students:

<table>
<thead>
<tr>
<th>Attendance</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm exam</td>
<td>100</td>
</tr>
<tr>
<td>Final exam</td>
<td>200</td>
</tr>
<tr>
<td>Homework assignment</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>600</td>
</tr>
</tbody>
</table>

For graduate students:

<table>
<thead>
<tr>
<th>Attendance</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm exam</td>
<td>100</td>
</tr>
<tr>
<td>Final exam</td>
<td>100</td>
</tr>
<tr>
<td>Homework assignment</td>
<td>100</td>
</tr>
<tr>
<td>Research paper</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>600</td>
</tr>
</tbody>
</table>

Note: Participation will be evaluated based on rubrics considering levels of participation/engagement in classroom discussions and interactions with instructors as well as other classmates.

Incomplete Grade Policy [http://registrar.arizona.edu/gradepolicy/incomplete.htm](http://registrar.arizona.edu/gradepolicy/incomplete.htm)

**Assignment/Testing Schedule:**

<table>
<thead>
<tr>
<th>Assignment/Testing</th>
<th>Date/Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm exam</td>
<td>March 12</td>
</tr>
<tr>
<td>Final exam</td>
<td>May 14</td>
</tr>
<tr>
<td>Research paper proposal due</td>
<td>March 23 (grad students only)</td>
</tr>
<tr>
<td>Research paper due</td>
<td>May 7 (grad students only)</td>
</tr>
</tbody>
</table>

**Research paper** (PLS 575A or ABE 575A):

Graduate students are expected to read various papers during the course and write a research paper on a specific topic regarding **plant-environment interactions**. The paper should be a critical review of current literatures on the topic chosen. The topic should emphasize application in plant production under controlled environment. Consult with instructor on the topic as soon as you select one. It is encouraged that students select a topic related to his/her research project. The maximum page limit of the paper is 10 pages (12 point, single spaced) including figures and tables.

**Teaching format (in-class, Section 001 students):**

- The course will be provided in lecture format; however several classes are expected to be outside the class room (e.g., Controlled Environment Agriculture Center greenhouses or commercial greenhouses) to provide hands-on experience.
- Lecture materials will be available for student access via our D2L course website.
Teaching format (online, Sections 002 and 910 students):
- Students in this course will have access to each learning module via our D2L course website.
- One module contains leaning materials (recorded Powerpoint lectures, lecture slides, reading materials).
- Additional readings will also be from pertinent research reports, review articles and selected chapters from books. Those will be also available from D2L course website. Students are expected to follow the schedule and study the materials available online.
- There will be discussion forum in D2L for each topic and student participation is expected.
- The module learning materials will become available for students’ access no later than at 8:00 am of the following date of the in-class lecture date. For example, Monday lecture will become available by 8:00 am on following Tuesday.
- Additional web-based communication tools (such as email, and Blackboard Collaborate) will be used as needed.
- There will be pre-scheduled live discussion meetings using Blackboard Collaborate.

Spring 2012 Course Schedule
Location: CEAC Classroom (Mon & Wed)

In-class schedule:
Week 1
January 15 (Wed) Introduction: Overview of CEA

Week 2
January 20 (Mon) no class (Martin Luther King Jr Holiday)
January 22 (Wed) SI unit & discussion

Week 3
January 27 (Mon) Plant responses to environmental conditions: Light - quantity and quality
January 29 (Wed) Plant responses to environmental conditions: Light - quantity and quality

Week 4
February 3 (Mon) Plant responses to environmental conditions: Photoperiod/Dark period
February 5 (Wed) Plant responses to environmental conditions: Gas

Week 5
February 10 (Mon) Plant responses to environmental conditions: Wind
February 12 (Wed) Plant responses to environmental conditions: Temperature

Week 6
February 17 (Mon) Plant responses to environmental conditions: Water and vapor
February 19 (Wed) Canopy environment: Leaf and canopy energy balance

Week 7
February 24 (Mon) Canopy environment: Leaf and canopy energy balance
February 26 (Wed) Canopy environment: Light and CO2 diffusion to canopy and environment inside plant canopy

Week 8
March 3 (Mon) Canopy environment: Scaling up from single leaf to the canopy
March 5 (Wed) Greenhouse Lab

Week 9
Mar 10 (Mon) Discussion
Mar 12 (Wed) **Midterm exam**

Mar 15 to 23 Spring Break

**March 23: Draft proposal of research paper due (graduate students only)**

**Week 10**
Mar 24 (Mon) Plant responses to environmental conditions: Rootzone Environment 1 (Nutrition and irrigation)
Mar 26 (Wed) Plant response to environmental conditions: Rootzone Environment 2 (Substrate)

**Week 11**
Mar 31 (Mon) Plant water relation
Apr 2 (Wed) Translocation of photosynthates: source/sink

**Week 12**
Apr 7 (Mon) Plant growth analysis
Apr 9 (Wed) Crop growth and yields under CEA

**Week 13**
Apr 14 (Mon) Greenhouse environment: I. Light transmission and energy balance in GH
Apr 16 (Wed) Greenhouse Environment: II. Gaseous environment and water balance in GH

**Week 14**
Apr 21 (Mon) Growth Chamber Environment: Lamps and Plant Production in Space
Apr 23 (Wed) Storage Environment I: Overview of postharvest biology and technology

**Week 15**
Apr 28 (Mon) Storage Environment II: Research topics
Apr 30 (Wed) In vitro Environment I: Overview of tissue culture production

**Week 16**
May 5 (Mon) In vitro Environment II: Research topics
May 7 (Wed) Discussion
   (Research Paper Due for grad students)

**May 7: Research Paper due**
**May 14: Final Exam**

**Activities for online students (mandatory for online students):**

Live discussion meeting I: January TBA
Live discussion meeting II: February TBA
Live discussion meeting III: March TBA
Live discussion meeting IV: April TBA

**Classroom Behavior**
Policy regarding use of cell phones/pagers
The Arizona Board of Regents' Student Code of Conduct
http://web.arizona.edu/~policy/threatening.pdf , ABOR Policy 5-308, prohibits
threats of physical harm to any member of the University community, including
to one’s self. See: http://policy.web.arizona.edu/~policy/threaten.shtml.

Special Needs and Accommodations Statement
Students who need special accommodation or services should contact the
Disability Resources Center, 1224 East Lowell Street, Tucson, AZ 85721, (520)
621-3268, FAX (520) 621-9423, email: uadrc@email.arizona.edu,
http://drc.arizona.edu/. You must register and request that the Center or DRC
send me official notification of your accommodations needs as soon as possible.
Please plan to meet with me by appointment or during office hours to discuss
accommodations and how my course requirements and activities may impact
your ability to fully participate. The need for accommodations must be
documented by the appropriate office.

Student Code of Academic Integrity
Students are encouraged to share intellectual views and discuss freely the
principles and applications of course materials. However, graded work/exercises
must be the product of independent effort unless otherwise instructed. Students
are expected to adhere to the UA Code of Academic Integrity as described in
the UA General Catalog. See:
http://deanofstudents.arizona.edu/codeofacademicintegrity

Confidentiality of Student Records
http://www.registrar.arizona.edu/ferpa/default.htm

Subject to Change Statement
Information contained in the course syllabus may be subject to change with
advance notice, as deemed appropriate by the instructors.