1. Instructor Information

Instructor Contact Information
Instructor name: Dr. Erin Sparks  
E-mail address: esparks@udel.edu  
Website: http://canr.udel.edu/faculty/erin-sparks/  
Office location: Delaware Biotechnology Institute, Room 283  
Office hours: By Appointment Only  
Phone number: 302-831-3428

Teaching Assistant Contact Information
TA name: Noah Ouslander  
E-mail address: noahous@udel.edu

2. Course Description

Prerequisites
None

Description
Hands-on and lecture-based introduction to controlled environment agriculture including the use of hydroponics for urban food production.

Course Delivery
Face-to-Face

3. Learning Outcomes

Working in teams, students will design a controlled environment growth system to address the needs of a community partner.
4. Learning Resources

Required Learning Materials

None - Learning materials will be provided through lecture notes and provided literature.

Technology

**CANVAS USE:** In this class, Canvas, UD's online learning management system, will be used for all course activities and communication channels. All assignments will be posted through the Canvas course site unless otherwise directed.

Information on how to use Canvas is available through the [Canvas Student Guide](https://community.canvaslms.com/docs/DOC-10701):

Canvas is accessible via MyUD or directly at [http://www.udel.edu/canvas](http://www.udel.edu/canvas).

5. Course Assessment

Final Grade Breakdown

The final course grade will be calculated using the following categories:

<table>
<thead>
<tr>
<th>Course Component</th>
<th>Percentage of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quizzes</td>
<td>10%</td>
</tr>
<tr>
<td>Course Projects</td>
<td>40%</td>
</tr>
<tr>
<td>Mid-Term Report</td>
<td>15%</td>
</tr>
<tr>
<td>Final Project</td>
<td>35%</td>
</tr>
</tbody>
</table>

*ADDITIONAL DETAILS FOR ALL ASSIGNMENTS CAN BE FOUND ON CANVAS.*

Quizzes (10%)  
Throughout the semester there will be quizzes at the culmination of each module that cover the major concepts presented in each module. Quizzes will be administered through Canvas, are due prior to the start of the next module, and will be worth 20 points each. Quizzes are **NOT** group work and should be taken as an individual.

As this course will contain a significant hands-on component, each student must complete safety training on BioRaft ([delaware.bioraft.com](http://delaware.bioraft.com)). Required trainings are listed on Canvas, and certificates of completion should be uploaded by the deadline. Successful completion of these trainings will result in 5 points.
Course Projects (40%)

Many of the course modules are associated with group-based, hands-on projects. The goal of these projects is to give you experience in a variety of aspects. Grading rubrics will be provided for each project, but as a general rule you will not be graded on your ability to master a construction or technology task, rather you will be graded on your ability to integrate the information presented from class, follow instructions, and justify your design decisions. This is work to be completed as a group, and the entire group will be assigned the same grade for each project. However, at the end of each project, members of the group will provide peer feedback as to the level of participation of their group members. If you are determined to be not participating, you will lose 5 points per project.

**Project 1: Onshape Design**
Due: Feb 24, 2019 @ 11:59pm
Points: 20 points
Description: (see Canvas)

**Project 2: Bato Buckets**
Due: Every Sunday starting Mar 3, 2019 @ 11:59pm
Points: 1 point per check-in, 10 points for final report, 21 points total
Description: (see Canvas)

**Project 3: Build Your Own Hydroponic System**
Due: Report Due Mar 24, 2019 @ 11:59pm; Prototype Due Mar 25, 2019 @ 3:35pm
Points: 30 points (20 for report, 10 for prototype)
Description: (see Canvas)

**Project 4: Build Your Own Lighting Array**
Due: Report Due Apr 21, 2019 @ 11:59pm; Prototype Due Apr 22, 2019 @ 3:35pm
Points: 40 points (25 for report, 15 for prototype)
Description: (see Canvas)

**Project 5: Build Your Own FarmBot Tool**
Due: Report Due May 5, 2019 @ 11:59pm; Prototype Due May 6, 2019 @3:35pm
Points: 30 points (20 for report, 10 for prototype)
Description: (see Canvas)

Mid-Term Report (15%)

In preparation for the final assignment, each student is responsible for preparing a 2-page mid-term report based on their research of existing growth systems in cargo shipping containers. A grading rubric will be provided via Canvas. This report is an individual assignment due on Canvas by 3:30pm on March 20th and worth 100 points.

Final Project (35%)

The final project for the course is to develop a design for a hydroponic growth facility within a cargo shipping container that fits the needs of the Tonic Theater Company. There are four components to the final project:
1. A preliminary design is due on Canvas by 3:30pm on May 6th. This assignment is worth 5 points, and all points will be awarded for turning in the assignment on time. The Instructor and TA will review the preliminary design and provide feedback for the final project.

2. A prototype of one design module (2x2) will be built and worth 25 points. This prototype must be completed before the final presentation on May 29, 2019 @ 3:35pm.

3. A 20-min final presentation of the design to Tonic Theater will be worth 25 points and occur on the last day of class - May 29, 2019.

4. A 5-page final report detailing the design and justification of design choices is worth 50 points and due May 29, 2019 by 11:59pm.

This is work to be completed as a group, and the entire group will be assigned the same grade for each component. A grading rubric for each component will be provided via Canvas. However, at the end of the semester, members of the group will provide peer feedback as to the level of participation of their group members. If you are determined to be not participating, you will lose 10 points from your overall grade.

### Grading Scale

Students will be assigned the following letter grade based on the calculation coming from the course assessment section.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Interval</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>93-100</td>
</tr>
<tr>
<td>A-</td>
<td>90-92</td>
</tr>
<tr>
<td>B+</td>
<td>87-89</td>
</tr>
<tr>
<td>B</td>
<td>83-86</td>
</tr>
<tr>
<td>B-</td>
<td>80-82</td>
</tr>
<tr>
<td>C+</td>
<td>77-79</td>
</tr>
<tr>
<td>C</td>
<td>73-76</td>
</tr>
<tr>
<td>C-</td>
<td>70-72</td>
</tr>
<tr>
<td>D+</td>
<td>67-69</td>
</tr>
<tr>
<td>D</td>
<td>63-66</td>
</tr>
<tr>
<td>D-</td>
<td>60-62</td>
</tr>
<tr>
<td>F</td>
<td>&lt;60</td>
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</tbody>
</table>
### Module I: Introduction to Controlled Environment Agriculture

**Dates:**
- (2 weeks) Mon, Feb 11th - Wed, Feb 20th

**Lectures:**
- Introduction to course and stakeholder introduction
- Introduction to CAD

**February 13, 2019** - Guest Lecture from Kurt Elftmann, Tonic Theater Company  
**February 18 & 20, 2019** - Guest Lecture from Brooks Twilley, MakerGym Director

**Greenhouse:**
- Tours and expectations

**Individual Assignments:**
- Upload Safety Training Certificates to Canvas by 3:30pm on 2/13 (counts towards Quizzes)  
- Quiz Due on Canvas by 3:30pm on 2/25

**Group Assignments:**
- On Shape Assignment Due to Canvas by 11:59pm on 2/22.

### Module II: Introduction to Hydroponics and Indoor Growth Systems

**Dates:**
- (2 weeks) Mon, Feb 25th - Wed, Mar 6th

**Lectures:**
- Discussion of UD CEA Systems and Plant Nutrition/Growth requirements

**March 6, 2019** - Guest Lecture from Karen Gartley, UD Soil Testing & Nancy Gregory, Plant Diagnostics

**Greenhouse:**
- Start Seedlings in Bato Buckets

**Individual Assignments:**
- Quiz Due on Canvas by 3:30pm on 3/11.

**Group Assignments:**
- Bato Bucket Check-In Due on Canvas by 11:59pm on 3/3.  
- Bato Bucket Check-In Due on Canvas by 11:59pm on 3/10.

### Module III: Horticultural Aspects of Indoor Growth Systems

**Dates:**
- (2 weeks) Mon, Mar 11th - Wed, Mar 20th

**Lectures:**
- Types of Crops and Potential Problems

**March 11, 2019** - Guest Lecture on Sustainability from Dr. Erik Ervin, Department Chair Plant and Soil Sciences  
**March 13, 2019** - Guest Lecture on Pathogens from Dr. Alyssa Koehler, Plant and Soil Sciences  
**March 18, 2019** - Guest Lecture on Fruit and Veggie Crops from Dr. Gordon Johnson, Plant and Soil Sciences  
**March 20, 2019** - Guest Lecture
<table>
<thead>
<tr>
<th>Module IV: Lighting</th>
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</thead>
<tbody>
<tr>
<td><strong>Dates:</strong></td>
<td>(3 weeks) Mon, Mar 25th - Wed, Apr 17th</td>
</tr>
<tr>
<td><strong>No Class Mon, Apr 1 &amp; Wed, Apr 3 for Spring Break</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Lectures:</strong></td>
<td>Introduction to Lighting and Design</td>
</tr>
<tr>
<td><strong>Greenhouse:</strong></td>
<td>Build Your Own Lighting Arrays</td>
</tr>
<tr>
<td><strong>Individual Assignments:</strong></td>
<td>Quiz Due on Canvas by 3:30pm on 4/22.</td>
</tr>
<tr>
<td><strong>Group Assignments:</strong></td>
<td>Bato Bucket Check-In Due on Canvas by 11:59pm on 3/31.</td>
</tr>
<tr>
<td></td>
<td>Bato Bucket Check-In Due on Canvas by 11:59pm on 4/14.</td>
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<tr>
<td></td>
<td>Bato Bucket Check-In Due on Canvas by 11:59pm on 4/21.</td>
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<tr>
<td></td>
<td>Lighting Array Report Due on Canvas by 11:50pm on 4/21.</td>
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<tr>
<td></td>
<td>Lighting Array Prototype Due in Class by 3:35pm on 4/22.</td>
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<thead>
<tr>
<th>Module V: Automation</th>
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</thead>
<tbody>
<tr>
<td><strong>Dates:</strong></td>
<td>(2 weeks) Mon, Apr 22nd - Wed, May 1</td>
</tr>
<tr>
<td><strong>Lectures:</strong></td>
<td>Introduction to Raspberry Pi and Sensors</td>
</tr>
<tr>
<td><strong>Greenhouse:</strong></td>
<td>Design Your Own FarmBot Tool</td>
</tr>
<tr>
<td><strong>Individual Assignments:</strong></td>
<td>Quiz Due on Canvas by 3:30pm on 5/6.</td>
</tr>
<tr>
<td><strong>Group Assignments:</strong></td>
<td>Bato Bucket Check-In Due on Canvas by 11:59pm on 4/28.</td>
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<tr>
<td></td>
<td>Bato Bucket Check-In Due on Canvas by 11:59pm on 5/5.</td>
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<tr>
<td></td>
<td>FarmBot Tool Report Due on Canvas by 11:59pm on 5/5.</td>
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<tr>
<td></td>
<td>FarmBot Tool Prototype Due in Class by 3:35pm on 5/6.</td>
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<thead>
<tr>
<th>Module VI: Project Design &amp; Construction</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Dates:</strong></td>
<td>(2.5 weeks) Mon, May 6th - Mon, May 20th</td>
</tr>
<tr>
<td>Lectures:</td>
<td>TBA</td>
</tr>
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</tr>
<tr>
<td>Greenhouse:</td>
<td>Construction of One 4x4 Module of Growth System Design</td>
</tr>
<tr>
<td>Individual Assignments:</td>
<td>N/A</td>
</tr>
</tbody>
</table>
| Group Assignments: | Preliminary Design Due on Canvas by 3:30pm on 5/6.  
| | Bato Bucket Check-In Due on Canvas by 11:59pm on 5/12.  
| | Final Bato Bucket Report Due on Canvas by 11:59pm on 5/19. |

### Final Presentation to Stakeholders

**Date:**  
- Wed, May 29th (3:30pm-5:30pm)

**Guest Evaluators:** Kurt Elftmann (Tonic Theater Company), Dr. Megan Killian (Biomedical Engineering)

**Group Assignments:**  
- Final Project Prototype Due in Class by 3:30pm on 5/29.  
- Final Project Presentation in Class by 3:30pm on 5/29.  
- Final Project Report Due on Canvas by 11:59pm on 5/29.
Course Policy Document

Attendance

Regular class attendance is strongly encouraged and expected for this course. While attendance is not part of your grade, the evaluation of assignments assumes course attendance and your performance will likely suffer without attending class.

Absences on religious holidays listed in University calendars is recognized as an excused absence. Nevertheless, students are urged to remind the instructor of their intention to be absent on a particular upcoming holiday. Absences on religious holidays not listed in University calendars, as well as absences due to athletic participation or other extracurricular activities in which students are official representatives of the University, shall be recognized as excused absences when the student informs the instructor in writing during the first two weeks of the semester of these planned absences for the semester.

Absence due to serious illness or death within a student's family is also recognized as an excused absence. To validate such an absence, the student must present evidence to the DEAN’S OFFICE of their college. The Dean’s Office will then provide a letter of verification to all of the student’s instructors for the term.

Absence due to serious illness of the student (e.g. hospitalization, surgery or protracted medical illness or convalescence) is also recognized as an excused absence. To validate such an absence, the student should present evidence to the DEAN’S OFFICE of their college. Supportive evidence will be provided on the student’s request by the Student Health Service directly to your dean.

Absence due to relatively minor, short-term illnesses of students (e.g. cold and flu, where attendance in class is undesirable) or their immediate families is also recognized as an excused absence. To validate such an absence, the student should present me with a written note from the University Health Services or a physician. If possible, please notify me prior to class.

Absence due to short-term military duty in the National Guard or active reserve is also recognized as an excused absence. To validate such an absence, the student should present evidence to the DEAN’S OFFICE of their college. The Dean's Office will then provide a letter of verification to all of the student's instructors for the term.

Students are not penalized if absent from an examination or lecture because of an excused absence. They are, however, responsible for all material presented and exams missed during their excused absence.

Late Work Policy

Late work is not accepted for this course. All assignments will close at the date and time they are due.

Communication

All notices and updates to class schedules will be posted through Canvas.

Academic Integrity

Please familiarize yourself with UD policies regarding academic dishonesty. To falsify the results of one's research, to steal the words or ideas of another, to cheat on an assignment, to re-submit the same assignment for different classes, or to allow or assist another to commit these acts corrupts the educational process. Students are expected to do their own work and neither give nor receive unauthorized assistance. Complete details of the university's academic integrity policies and procedures can be found at http://www1.udel.edu/studentconduct/policyref.html Office of Student Conduct, 218 Hullihen Hall, (302) 831-2117. E-mail: student-conduct@udel.edu
Harassment and Discrimination

The University of Delaware works to promote an academic and work environment that is free from all forms of discrimination, including harassment. As a member of the community, your rights, resource and responsibilities are reflected in the non-discrimination and sexual misconduct policies. Please familiarize yourself with these policies at http://www.udel.edu/oei. You can report any concerns to the University’s Office of Equity & Inclusion, at 305 Hullihen Hall, (302) 831-8063 or you can report anonymously through UD Police (302) 831-2222 or the EthicsPoint Compliance Hotline at http://www1.udel.edu/compliance. You can also report any violation of UD policy on harassment, discrimination, or abuse of any person at this site: http://sites.udel.edu/sexualmisconduct/how-to-report/

Faculty Statement on Disclosures of Instances of Sexual Misconduct

If, at any time during this course, I happen to be made aware that a student may have been the victim of sexual misconduct (including sexual harassment, sexual violence, domestic/dating violence, or stalking), I am obligated to inform the university’s Title IX Coordinator. The university needs to know information about such incidents in order to offer resources to victims and to ensure a safe campus environment for everyone. The Title IX Coordinator will decide if the incident should be examined further. If such a situation is disclosed to me in class, in a paper assignment, or in office hours, I promise to protect your privacy—I will not disclose the incident to anyone but the Title IX Coordinator. For more information on Sexual Misconduct policies, where to get help, and how to reporting information, please refer to http://www.udel.edu/sexualmisconduct. At UD, we provide 24-hour crisis assistance and victim advocacy and counseling. Contact 302-831-1001, UD Helpline 24/7/365, to get in touch with a sexual offense support advocate.

For information on various places you can turn for help, more information on Sexual Misconduct policies, where to get help, and reporting information please refer to http://www.udel.edu/sexualmisconduct

Inclusion of Diverse Learning Needs

Any student who thinks he/she may need an accommodation based on a disability should contact the Office of Disability Support Services (DSS) office as soon as possible. The DSS office is located at 240 Academy Street, Alison Hall Suite 130, Phone: 302-831-4643, fax: 302-831-3261, DSS Website (http://www.udel.edu/DSS/). You may contact DSS at dssoffice@udel.edu

Non-Discrimination

The University of Delaware does not discriminate against any person on the basis of race, color, national origin, sex, gender identity or expression, sexual orientation, genetic information, marital status, disability, religion, age, veteran status or any other characteristic protected by applicable law in its employment, educational programs and activities, admissions policies, and scholarship and loan programs as required by Title IX of the Educational Amendments of 1972, the Americans with Disabilities Act of 1990, Section 504 of the Rehabilitation Act of 1973, Title VII of the Civil Rights Act of 1964, and other applicable statutes and University policies. The University of Delaware also prohibits unlawful harassment including sexual harassment and sexual violence.

For inquiries or complaints related to non-discrimination policies, please contact: Director, Institutional Equity & Title IX Coordinator- Susan L. Groff, Ed.D. groff@udel.edu 305 Hullihen Hall Newark, DE 19716 (302) 831-8063

For complaints related to Section 504 of the Rehabilitation Act of 1973 and/or the Americans with Disabilities Act, please contact: Director, Office of Disability Support Services, Anne L. Jannarone, M.Ed., Ed.S. - ajannaro@udel.edu Alison Hall, Suite 130, Newark, DE 19716 (302) 831-4643 OR contact the U.S. Department of Education - Office for Civil Rights (https://wdcrobcolp01.ed.gov/CFAPPS/OCR/contactus.cfm)