# HRT 351 - Hydroponic Food Production (2 credits)

Department of Horticulture
Michigan State University
Fall Semester, 2025

## Part I. Course Information


**Instructor**
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**Lecture Location**
Lecture: Tuesday and Thursday, 12:40 to 1:30 PM in A149 Plant & Soil Science Bldg.

## Course Communication

As the instructor for HRT 351, I am here to answer your questions to ensure you meet the outlined learning objectives by the completion of the course. I do not have scheduled office hours, but meeting times may be arranged by making an appointment via e-mail. Please review the many communication options below to ensure that our interactions are efficient for all parties.

- The best way to reach me outside of class is by sending me an e-mail. Please email me at rglopez@msu.edu or through the D2L email option (both will go to the same mailbox). I will respond to whichever email you use, so be sure to check that same mailbox.
    - Allow me at least 24 hours (48 hours on the weekends) to provide a response. I will likely be checking my email more frequently, but allow this much time before projects are due and exams.
    - I will email the class from the D2L website, which automatically goes to your D2L mailbox. If you have not already, consider adding a forwarding email address in the settings of your D2L mail to ensure you are getting all correspondence.
    - Professional email etiquette is expected. For more information on what that means, please visit the article, "The Do's and Don'ts of Email Etiquette." (https://www.entrepreneur.com/article/272780)
- Alternatively, feel free to stop by my office PSSB, Room 330 to see if I'm available.
- I strongly encourage you to ask questions at any time and not wait unit the day before the exam.
- Many students don't know how to address their professors or instructors. You are free to call me by my first name (Roberto), or as Dr. Lopez. You may choose whichever is most comfortable.

## Course Prerequisites

It is expected that students enrolled in this course will have successfully passed and completed HRT 203 (Principles of Horticulture) and HRT 204 (Plant Propagation) or concurrently taking at MSU or a similar course at another location. Students will need to be familiar with the basic concepts of greenhouse crop culture including environment (light, temperature) and culture (irrigation water, fertility).

## Course Description

Hydroponic systems are widely used in the production of food crops such as leafy greens, microgreens, herbs, and fruiting crops in controlled-environment agriculture (CEA). In this course, we will take an interdisciplinary approach and learn about hydroponic systems used to grow food crops in commercial high tunnels, greenhouses, and indoor (warehouses, containers, and vertical farms) operations. Other topics we will cover include: manipulation of and crop response to the aerial and root-zone environments including: nutrient solution chemistry, preparation and management, crop physiology and maintenance, production scheduling, environmental and cultural control, economics and marketing, integrated pest management, and food safety.

Lectures, videos, supplemental readings, discussions, and projects are designed to develop the knowledge, skills, and techniques necessary to succeed in hydroponic production as a future grower, manager, entrepreneur, consultant, policymaker, hobbyist, or a related profession. A laboratory course (HRT 351L) affiliated with this course is optional and open to upper-level undergrads.

### Course Textbooks, Podcasts, and Supplemental Materials

The recommended textbook for this course can be purchased from online retailers, the MSU Spartan Bookstore in the International Center or any of the East Lansing bookstores. To be successful in this course, complete readings and listen to podcasts prior to lecture. You will find more value in lectures if you have already familiarized yourself with the topic and can listen to the lectures already knowing some of the basics. Reading and listening to podcasts before class will also help you identify areas that need clarification and allow you to ask more specific questions.

- ***Recommended***
  - *Hydroponic Food Production, 8th Ed. Howard M. Resh, CRC Press*
    - *ISBN: 978-0367678753*
- **Internet access**:
  - ***Recommended podcasts:*** Pre-recorded podcasts covering some course topics are available online on the Electronic Growers Resources Online (e-GRO) website: *http://e-gro.org/university.php*
  - ***Required handouts and other course materials:*** Some course materials will be available online through the course management system (D2L) at: http://d2l.msu.edu

To be successful in this course, complete readings prior to lecture. You will find more value in lectures if you have already familiarized yourself with the topic and can listen to the lectures already knowing some of the basics. Reading before class will also help you identify areas that need clarification and allow you to ask more specific questions during lecture (which is great!).

## Part II. Course Goals and Objectives

### Course Goals

Upon completion of HRT 351 students will be able to work with a variety of hydroponic and aquaponic systems used in food crop production, produce a variety of food crops in hydroponic systems, and critically analyze hydroponic food production system benefits and limitations.

### Course Objectives

After completing this course, students will be able to:

- Describe essential components of a hydroponic system.
- Understand the importance of water quality, dissolved oxygen, salinity, and pH management for hydroponic production.
- Critically evaluate and compare various hydroponic systems and crops.
- Develop an understanding of controlled environment hydroponic food crop production and the science behind the technologies utilized.

- Describe the role of hydroponic food production in food security and climate change.
- Understand principles of water chemistry and plant nutrition, do nutrient solution calculations, and diagnose common nutrient disorders.

### Desired Learning Outcomes

- Ability to explain how hydroponic systems are designed to meet the physical, chemical, and biological needs of plant roots.
- Ability to discuss the benefits and constraints of several different hydroponic systems and hydroponically grown food crops.
- Ability to articulate the ideal growing environment and plant response to temperature, light, and carbon dioxide for several of the most common hydroponically grown crops.
- Ability to describe the most common plant biotic and abiotic disorders.
- Ability to articulate how hydroponics relates to sustainable, organic, and local food production.

## Part III. Course Outline and Schedule

The course schedule below describes the lecture outline (subject to change). The first column contains the lecture date, the second column includes the grower week, the third column includes the lecture topic or course activity, the forth column has information about student preparation for the class period (readings and podcasts) and assignments due on that date and the fifth is the lecturer. ***Readings are from the required textbook, unless otherwise stated.***

| Lecture date | Grower week | Lecture activity | Reading or assignment | Lecturer |
|---|---|---|---|---|
| Aug. 26 (T) | 35 | Lecture 1: Controlled environment agri. and hydroponics: Past, present, and future | Chapter 1 | Lopez |
| Aug. 28 (Th) | 35 | Lecture 2: Hydroponic systems | Chapters 4, 5, 6, 10, 11 and 13 | Lopez |
| Sept. 2 (T) | 36 | Lecture 3: Hydroponic systems | | Lopez |
| Sept. 4 (Th) | 36 | Lecture 4: Temperature management | Chapter 12<br>**Quiz 1 DUE** | Lopez |
| Sept. 9 (T) | 37 | Lecture 5: Temp/Light management | Chapter 12 | Lopez |
| Sept. 11 (Th) | 37 | Lecture 6: Light management | | Lopez/ Smith |
| Sept. 16 (T) | 38 | Lecture 7: Light management/Gases | pg. 496-497<br>**Quiz 2 DUE** | Lopez/ Smith |
| Sept. 18 (Th) | 38 | Lecture 8: Gases | | Lopez |
| Sept. 23 (T) | 39 | Lecture 9: Water and nutrients | Chapter 2 & 3 | Lopez |
| Sept. 25 (Th) | 39 | Lecture 10: Water and nutrients | **Exam I** | Lopez |
| Sept. 30 (T) | 40 | Lecture 11: Water and nutrients | | Lopez |
| Oct. 2 (Th) | 40 | Lecture 12: Water and Nutrients | **Business plan Part I DUE** | Lopez |
| Oct. 7 (T) | 41 | Lecture 13: Strawberries | CEA Berry | Lopez |
| Oct. 9 (Th) | 41 | Lecture 14: Strawberries & leafy greens: Lettuce, Kale, Arugula, etc. | pg. 561-562, 167, 172-182,491-493<br>**Quiz 3 DUE**<br>**Wikipedia Article Part I DUE** | Lopez |
| Oct. 14 (T) | 42 | Lecture 15: High wire crops: Cucumbers | pg. 498-530, 557-561 | **Owen** |
| Oct. 16 (Th) | 42 | Lecture 16: Grafting | pg. 562-570 | **Hernandez** |
| **Oct. 21 (T)** | **43** | **Fall Break – No class** | | |
| Oct. 23 (Th) | 43 | Lecture 17: Leafy greens | **Quiz 4 DUE** | Lopez |
| Oct. 28 (T) | 44 | Lecture 18: Culinary herbs | pg. 139-142, 140-147, 179, 182-191; 184-192<br>**Wikipedia Article Part II DUE** | Lopez |
| Oct. 30 (Th) | 44 | Lecture 19: Culinary herbs/ Microgreens | **Exam II**<br>pg. 561-562, 167, 172-182,491-493 | Lopez |
| Nov. 4 (T) | 45 | Lecture 22: High wire crops: Tomatoes | pg. 498-530, 557-561<br>**MEME DUE** | Lopez |
| Nov. 6 (Th) | 45 | Lecture 23: High wire crops: Tomatoes | pg. 498-530, 557-561<br>**Quiz 5 DUE** | Lopez |
| Nov. 11 (Tu) | 46 | Lecture 24: Aquaponics | **Business plan Part II DUE** | **Currey** |

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|---|---|---|---|---|
| Nov. 13 (Th) | 46 | Lecture 25: Food safety | Guidelines for Food Safety in Hydroponic Production | **Shaw** |
| Nov. 18 (Tu) | 47 | Lecture 26: Gotham Greens | | **Frymark** |
| Nov. 20 (Th) | 47 | Lecture 27: Emerging CEA: Hemp | **Wikipedia Article Part III DUE** | **Faust** |
| Nov. 25 (Tu) | 48 | Lecture 28: Virtual documentary screening – "Hearts of Glass" | https://vimeo.com/752672347 **Password: HofG-Private** | At home |
| Nov. 27 (Th) | 48 | Thanksgiving – No Class | | |
| Dec. 2 (T) | 49 | Lecture 29: Emerging CEA: Indoor Farming | Chapter 14 **Quiz 6 DUE** | **Runkle** |
| Dec. 4 (Th) | 49 | **Lecture 30: Student choice** | **Exam III** | Lopez |

***The above schedule is tentative and is subject to change

## Part IV. Grading Policy

### Assignments and Grading

*Exams and Quizzes*

Exams and quizzes will include different question formats (multiple-choice, fill-in-the-blank, and short- and long-answer essays).

*Grading*

92-100% = 4.0
85-92% = 3.5
80-84% = 3.0
75-79% = 2.5
70-74% = 2.0
65-69% = 1.5
60-64% = 1.0
< 60% = 0

### Late Work and Make-Up Policy

All assignments are due on the assigned due date. **No late assignments will be accepted**, unless the student contacts us ahead of time AND has extenuating circumstances. Assignments **cannot** be handwritten and must be submitted via D2L. **No e-mailed assignments will be accepted.**

There will be no make-ups for missed quizzes or paper discussions for any reason. The lowest quiz score will be dropped. Make-ups for exams MUST be discussed with the professor BEFORE the exam in order to be considered for an alternative testing time. No exceptions (ie. unless you are hospitalized).

### Viewing Grades

Grades will be posted on D2L for all assignments, quizzes, and tests. Please keep the assignments handed back to you and double-check your grades in D2L to avoid discrepancies.

## Total point breakdown for the course

| Item | Points |
|---|---|
| ***Exams*** | |
| Exams 1, 2 and 3 | 150 each |
| **Subtotal** | **450** |
| ***Quizzes*** | |
| Quiz 1-6* | 10 each |
| (*Lowest quiz score dropped)<br>**Subtotal** | **50** |
| ***Hydroponic food crop business plan*** | |
| **Crops, Location and Marketing**<br>• Crop and justification<br>• Production system & justification<br>• Growing environment<br>• Location & customer base<br>• Target market | 60 points |
| **Crop, System, and Protocols**<br>• In-depth crop culture<br>• Harvest and post-harvest protocols<br>• Food safety plan | 40 points |
| **Logical formatting** | 5 points |
| **Citations** | 5 points |
| **Subtotal** | **110** |
| ***Wikipedia Article*** | |
| • 1-page -page report describing the selected topic – what is the subject? What is lacking about the topic on Wikipedia.org? What are some potential primary references you can include? | 10 points |
| • Draft and a minimum of 5 primary literature citations | 10 points |
| • Final version of Wikipedia.org entry | 30 points |
| **Subtotal** | **50** |
| ***Informational Hydroponics Meme*** | |
| | 20 points |

| | |
|---|---|
| **Subtotal** | **20** |
| ***Class attendance and participation*** | |
| 28 lectures x 4 points per class* | |
| (*3 missed lectures dropped) | 100 points |
| Participation | 20 points |
| **Subtotal** | **120** |
| **Grand total** | **800** |


## Part V: Course and University Policies

### Attendance

Students who fail to attend the first four class sessions or class by the fifth day of the semester, whichever occurs first, may be dropped from the course.

### Participation

Students are expected to attend and participate in all classroom activities. A participation grade will be assigned based on attendance and participation.

### Understand When You May Drop This Course

The last day to add this course is the end of the first week of classes (8/29/25). The last day to drop this course with a 100 percent refund and no grade reported is 9/18/25. The last day to drop this course with no refund and no grade reported is 10/13/25. You should immediately make a copy of your amended schedule to verify you have added or dropped this course.

### Course Behavior and Etiquette

We expect a professional, enthusiastic, and congenial atmosphere where we all feel: 1) welcome; and 2) respected. We will be learning together and, in order to get the greatest benefits of the class, everyone needs to feel comfortable participating and engaging with each other. We understand that your classmates represent a rich variety of backgrounds and perspectives. While working together to build this classroom community we ask all members to:

**Please…**

- Be patient with us as this is a relatively new course and we are trying new methods.
- Get to know myself and the TAs better.
- Be prepared with the readings done ahead of time.
- Be enthusiastic and excited, this is going to be a really fun course!

- Ask questions and don't be shy to ask for clarification.
- Be open to the views of others.
- Be on time and quiet down when I start lecture.
- Appreciate the opportunity that we have to learn from each other in this course
- Value and honor each other's opinions, uniqueness, and communicate in a respectful manner.

**Please *do not*…**

- Use poor language or mock other students.
- Wear sunglasses or inappropriate clothing in the classroom.
- Read the newspaper, text, or surf the internet or use a computer for non-class related work.
- Use your cell phone in any way unless there is an emergency.
- Carry conversations with your friends during class.

Article 2.III.B.4 of the Student Rights and Responsibilities (SRR) for students at Michigan State University states: "The student's behavior in the classroom shall be conducive to the teaching and learning process for all concerned." Article 2.III.B.10 of the SRR states that "The student and the faculty share the responsibility for maintaining professional relationships based on mutual trust and civility." General Student Regulation 5.02 states: "No student shall . . . interfere with the functions and services of the University (for example, but not limited to, classes . . .) such that the function or service is obstructed or disrupted. Students whose conduct adversely affects the learning environment in this classroom may be subject to disciplinary action through the Student Judicial Affairs office.

## Accommodations for Students with Disabilities

Accommodations for Students with Disabilities (from the Resource Center for Persons with Disabilities (RCPD): Michigan State University is committed to providing equal opportunity for participation in all programs, services and activities. Requests for accommodations by persons with disabilities may be made by contacting the Resource Center for Persons with Disabilities at 517-884-7273, TTY: 517-355-1293 or on the web at Resource Center for Persons with Disabilities. Once your eligibility for an accommodation has been determined, you will be issued a Verified Individual Services Accommodation ("VISA") form. Please present this form to me at the start of the term and/or two weeks prior to the accommodation date (test, project, etc.). Requests received after this date may not be honored.

**Academic Honesty**

Article 2.III.B.2 of the Students Rights and Responsibilities SRR states: "The student shares with the faculty the responsibility for maintaining the integrity of scholarship, grades, and professional standards." In addition, HRT 221 adheres to the policies on academic honesty specified in General Student Regulation 1.0, Protection of Scholarship and Grades; the all-University Policy on Integrity of Scholarship and Grades; and Ordinance 17.00, Examinations. (See Spartan Life: Student Handbook and Resource Guide)

Therefore, unless authorized by your instructor, you are expected to complete all course assignments, including homework, quizzes, and exams, without assistance from any source. You are expected to develop original work for this course; therefore, you may not submit course work you completed for another course to satisfy the requirements for this course. Students who violate MSU regulations on Protection of Scholarship and Grades will receive a failing grade in the course or on the assignment.

Faculty are required to report all instances in which a penalty grade is given for academic dishonesty. Students reported for academic dishonesty are required to take an online course about the integrity of scholarship and grades. A hold will be placed on the student's account until such time as the student completes the course. This course is overseen by the Associate Provost for Undergraduate Education.

**Use of AI Tools**

The use of generative AI tools (e.g. ChatGPT, Dall-e, etc.) is permitted in this course for the following activities:

- Brainstorming and refining your ideas;
- Finding information on your topic;
- Drafting an outline to organize your thoughts; and
- Checking grammar and style.

***The use of generative AI tools is NOT permitted in this course for the following activities:***

- Using meme generators to create your course meme
- Impersonating you in classroom contexts, such as by using the tool to compose discussions.

- Writing a draft of a writing assignment.
- Writing entire sentences, paragraphs or papers to complete class assignments.
- Searching for answers during an exam or assessment.

You are responsible for the information you submit based on an AI query (for instance, that it does not violate intellectual property laws, or contain misinformation or unethical content). Your use of AI tools must be properly documented and cited in order to stay within university policies on academic integrity and the Spartan Code of Honor Academic Pledge. All written works submitted in this course will be run through plagiarism software. Any assignment that is found to have used generative AI tools in unauthorized ways *will not be graded.* When in doubt about permitted usage, please ask for clarification.

**Campus Emergencies**

If an emergency arises in this classroom, building or vicinity, your instructor will inform you of actions to follow to enhance your safety. As a student in this class, you are responsible for knowing the location of the nearest emergency evacuation route or shelter. These directions appear on the maps posted on the walls throughout this building. If police or university officials order us to evacuate the classroom or building, follow the posted emergency route in an orderly manner and assist those who might need help in reaching a barrier-free exit or shelter. To receive emergency messages, set your cellular phones on silent mode when you enter this classroom. If you observe or receive an emergency alert, immediately and calmly inform your instructor. (www.alert.msu.edu).