HRT 221- Greenhouse Structures and Management

Department of Horticulture
Michigan State University
Fall semester, 2026

Part I. Course Information

Instructor
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Teaching Assistant
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Lecture Times and Location
Tuesday and Thursday, 12:40 to 2:00 PM in A155 PSSB

Course Communication

As the instructor for HRT 221, I'm here to answer your questions to ensure you meet the outlined learning goals by the completion of the course. Please review the communication options below to ensure that our interactions are efficient for all parties.

We do not have scheduled office hours, but in-person or Zoom meeting times can be arranged by making an appointment in advance. The best way to reach me outside of class is by email. I strongly encourage you to ask questions at any time, rather than waiting until the day before the exam, before an assignment is due, or at the end of the semester.

Many students don't know how to address their professors or instructors. You are free to call me by my first name (Roberto) or Dr. Lopez. You may choose whichever is most comfortable.

E-mail

- Please email us directly at the addresses above. I will respond to whichever email you use, so be sure to check that same mailbox.
- Allow us at least 24 hours (48 on the weekends) to provide a response. We will likely be checking my email more frequently, but allow this much time before projects, assignments, and exams are due.
- We will email the class from the D2L website, which automatically goes to your D2L mailbox. If you have not already done so, consider adding a forwarding email address in your D2L mail settings to ensure you receive 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

Phone

- You are welcome to call Dr. Lopez at 517-353-0342. If I do not answer, please leave a message. Your message will be emailed to me if I am not in the office.

Zoom

- We can use Zoom to video conference. This option allows us to share screens, should that be helpful.
- Please email us with date and time options that you are available to "meet," and we will let you know what will work.
- You can log in to use Zoom at https://msu.zoom.us/ using your MSU NetID and password.
- There is also a Zoom app available that you could use on your phone; sharing digital content may be more difficult this way.

Course Description

HRT 221 is an introductory-level course that provides the principles and practices of commercial greenhouse construction, operation, and management. Site selection and orientation, greenhouse structures and coverings, shading materials, and heating, cooling, and ventilation requirements and equipment are discussed. Methods and equipment for planting, lighting, media/substrate preparation, irrigation, fertilization, and plant growth regulators management of greenhouse crops are presented.

Course Textbooks, Podcasts, and Materials

Textbooks for this course can be purchased from online retailers. To be successful in this course, complete the readings and listen to the required podcasts prior to the lecture. You will get more value from lectures if you have already familiarized yourself with the topic and can listen with some of the basics already known. Reading and listening to podcasts before class will also help you identify areas that need clarification and allow you to ask more specific questions.

- **Internet access**:
  - ***Required podcasts:*** Prerecorded 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
  - ***Webcam or Smartphone camera for use on Zoom office hour calls***

- ***Recommended textbook:***
  - Greenhouse Operations and Management, 7th ed. 2012. Paul V. Nelson. Pearson/Prentice Hall, Upper Saddle River, NJ.
  - Ball RedBook, Vol. 1, Structures and Equipment, 19th ed. 2021. Chris Beytes, ed. Ball Publishing, West Chicago, IL.

Course Goals

Upon completion of HRT 221, students will be able to identify greenhouse structures, components, and equipment; collect and calculate relevant cultural and environmental data; and critically analyze a commercial greenhouse.

Desired Learning Outcomes

- Critically evaluate greenhouse design, structure, operation, and management;
- Describe the differences between production, research, teaching, display, public, and hobby greenhouses;
- Identify the criteria used for commercial greenhouse site selection, orientation, layout, structures, coverings, ventilation, shading, and equipment;
- Understand routine greenhouse operations and general environmental and cultural procedures, including light, temperature, humidity, water, media, nutrient, and height management;

- Calculate heating and cooling requirements; fertilizer, acid, and plant growth regulator rates and preparations; understand limitations of online grower calculators;
- Summarize primary and secondary literature and synthesize information for greenhouse operations;
- Establish a base of knowledge for higher-level greenhouse crop production courses.

Part III. Course Outline and Schedule

The course schedule below outlines the lectures (subject to change). The 1st column contains the lecture week, the 2nd column contains the lecture date, the 3rd column contains the lecture topic or course activity, the 4th column contains information about student preparation for the class period (readings and podcasts) and assignments due on that date, and the 5th column lists the lecturer. ***Readings are from the required textbook, and podcasts are from e-gro.org (click on the university tab), unless otherwise stated.***

Week	Lecture date	Topic, course activity	Recommended reading (GO&M), required podcast or assignment	Lecturer
1	Sept. 1	Syllabus Overview & Greenhouse Industry	Read: Syllabus (on D2L) Chapter 1; pg. 1 to 32	Lopez
	Sept. 3	Site Selection, Orientation, Structures	Podcast: Structure Types & Terminology Chapter 2; pg. 35 to 39	Lopez
2	Sept. 8	Greenhouse Coverings and Structures	Podcast: Glazing Materials; Chapter 2; pg. 39 to 65; Optional: Greenhouse Cover technology PDF; pg. 291 to 334	Lopez
	Sept. 10	Benches, Spacing & Moving Plants/ Primary & Secondary literature	Podcast: Spacing Chapter 2; pg. 65 to 74 **Quiz 1 Due**	Lopez
3	Sept. 15	Light	Podcasts: Managing Photoperiod, Measuring & Monitoring Photosynthetic Light, Managing Photosynthetic Light; Chapter 4	**Smith**
	Sept. 17	Light and CO_2/ Primary Literature Discussion	Chapter 11; pg. 329 to 361 Podcast: CO_2 injection **Primary Literature 1 Summary Due**	**Smith**
4	Sept. 22	Benches & GH heating system	Chapter 3; pg. 77 to 108	Lopez
	Sept. 24	Greenhouse Heating Calculations	Chapter 3; pg. 109 to 118 Podcast: Overview of greenhouse heating	Lopez
5	Sept. 29	Catch up/ Cooling systems	Podcast: Greenhouse Cooling; Chapter 4 **Quiz 2 Due**	Lopez
	Oct. 1	Greenhouse Cooling Systems & Calculations	Podcast: Greenhouse Cooling; Chapter 4	Lopez
6	Oct. 6	Greenhouse Environ. – Temperature	Podcast: Effects of Temperature on Greenhouse Crops & Measuring Temp. in a Greenhouse; Chapter 11; pg. 361 to 369	Lopez
	Oct. 8	Exam 1	In class	Lopez
7	Oct. 13	Temperature and Plant Growth Regulation	Podcast: Environ. & Cultural Management of Plant Growth; PGR options; Chapter 12; pg. 373 to 389 **Heating Calculations Due**	Lopez
	Oct. 15	Irrigation Water Systems	Podcast: Watering plugs, bedding plants, and watering potted crops Chapter 8; pg. 224 to 258	Lopez
8	Oct. 20	Irrigation Water Quality	Podcast: Understanding alkalinity and an overview of irrigation methods Chapter 8; pg. 211 to 224 **Quiz 3 Due**	Lopez
	Oct. 22	Mineral Nutrition-Fertilization Programs	Podcast: Water-soluble fertilizers and controlled-release fertilizers Chapter 9; pg. 261 to 291 **Cooling Calculations Due** **Quiz 4 Due**	Lopez
9	Oct. 27	Fall Break	No Class	
	Oct. 29	Tour of Teaching & Research GHs	**Light & Temperature Calculations Due**	Particka, Wood,

10	Nov. 3	Growing Substrates- properties and components	Podcast: Media Physical Properties, Part 1 and 2; Chapter 6; pg. 161 to 176 **Primary Literature Summary 2 Due**	Lopez
	Nov. 5	Growing Substrates- Components, Mixing and Management	Podcast: Mixing, Handling, and Filling Media Chapter 6; pg. 176 to 193	Lopez
11	Nov. 10	Exam 2		Lopez
	Nov. 12	Field Trip	Required Field Trip to Grand Rapids **Quiz 5 Due**	Lopez
12	Nov. 17	Insect Management	Chapter 13; pg. 391 to 421	Lopez
	Nov. 19	Catch up & Primary Literature Discussion	**Primary Literature Summary**	Lopez
13	Nov. 24 Nov. 26	Thanksgiving	No class	Lopez
14	Dec. 1	Physiological Disorders		Lopez
	Nov. 23	Disease Management	Chapter 14; pg. 443 to 461 **Field Trip Summary DUE**	Hausbeck
15	Dec. 8	Cost Accounting	**Quiz 6 Due**	Valle de Souza
	Dec. 9	Exam 3		Lopez

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

Part III. Grading Policy

Assignments and Grading

Exams and D2L Quizzes

Exams and quizzes will include different question formats (multiple-choice, fill-in-the-blank, and short- and long-answer essays) and will be on D2L.

There are calculations in the course that you will be tested on. Therefore, you are allowed to use a calculator (not a phone) on all exams.

Greenhouse calculations

One of the most important jobs of anyone in a greenhouse is to be comfortable with a variety of calculations- from heating and cooling to plant growth regulator mixing. Throughout the semester, three problem sets involving calculations will be assigned and are due according to the schedule above.

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

Primary and secondary literature summary and discussion

See the handout in D2L.

Table 1. Total point breakdown for the course

Item	Points
D2L Exams	
Exams 1, 2, and 3	150 each
Subtotal	**450**
D2L Quizzes	10 each
Quiz 1-6*	
(*The lowest quiz score will be dropped) **Subtotal**	**50**
Calculations	
Heating calculations	25 each
Cooling calculations	
Light and temperature calculations	
(*The lowest calculation score will be dropped)	
Subtotal	**50**
Paper Discussions and Summary	
Summary 1	25 each
Summary 2	
Summary 3	
Subtotal	**75**
Virtual Field Trip	
2-page summary	**50**
Group Greenhouse Tasks	**75**
Class attendance and participation	
Answering questions, asking questions, and participating in course discussions	
Subtotal	**50**
Grand total	**800**
Extra credit	
Attend one day of the MI greenhouse EXPO from December 10 to 11. https://glexpo.com/ and write a 1-pg summary of what you learned	**25**

Late Work and Make-Up Policy

All assignments are due on the assigned due date in class **(assignments sent via e-mail will not be accepted). No late assignments will be accepted**, unless the student contacts us ahead of time AND has extenuating circumstances.

There will be no make-ups for missed quizzes or paper discussions for any reason or recorded lectures. The lowest scores will be dropped for both quizzes and calculations. Make-ups for exams MUST be discussed with Dr. Lopez BEFORE the exam in order to be considered for an alternative testing time. No exceptions (ie. unless you have a doctor's note or are hospitalized).

Ensure that you know someone in class who can record lectures for you in the event you are sick or hospitalized.

Viewing Grades

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

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. Attendance will be taken for all lectures.

Participation

Students are expected to attend and participate in all classroom activities and labs. 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. The last day to drop this course with a 100 percent refund and no grade reported is 9/18/26. The last day to drop this course without a refund and without a grade being reported is 10/16/26. You should immediately make a copy of your amended schedule to verify you have added or dropped this course.

Commercialized Lecture Notes

Commercialization of lecture notes and university-provided course materials is not permitted in this course.

Course Behavior

I expect a professional and congenial atmosphere where we all feel: 1) welcome; and 2) respected. We will be learning together and, to get the greatest

benefit from the class, need to feel comfortable participating and engaging with each other.

Please *do*…
…ask questions.
…ask for clarification.
…send me an email if you don't understand a concept.
…keep your mask on at all times and stay home if you feel ill.
…be excited- this is going to be a really fun course!
Please *do not*…
…use poor language.
…wear sunglasses in the classroom.
…use a computer for non-class-related work.
…use your cell phone in any way unless there is an emergency.
…come in late and disrupt the class.
…come to class if you are feeling ill.

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 https://www.rcpd.msu.edu/. 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 (e.g., test, project). 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 coursework you completed for another course to satisfy the requirements for this course. Also, you are not authorized to use the www.allmsu.com website to complete any coursework in this course. Students who violate MSU regulations regarding the Protection of Scholarship and Grades will receive a failing grade for the course or 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 the student completes the course. This course is overseen by the Associate Provost for Undergraduate Education.

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 to silent mode when you enter this classroom. If you observe or receive an emergency alert, immediately and calmly inform your instructor. (http://alert.msu.edu/).