

# EE 460 Continuous Control Systems (revised 10/20/23)

**Pre-requisite:** EE 420 with a minimum grade of C or ME 310 with a minimum grade of C and MATH 307  
**Credit:** 3.5 credit hours  
**Instructor:** Stacy Wilson, Ph.D., P.E.  
**Office:** COHH 2114  
**Office Hours:** By appointment  
**Email:** stacy.wilson@wku.edu  
**Phone:** 270-745-3251

## **Course Description:**

A study of continuous control systems that will address the following topics: system modeling, feedback systems, systems stability, root locus plots, Bode plot, state space analysis, and design of controllers. Laboratory included.

## **Course Objectives:**

1. Students will be introduced to the art of control theory.
2. Students will learn various techniques to design control systems.
3. Students will clearly understand system stability and its impacts on system design.

## **Course Outline:**

Systems (Chapters 2 and 3)  
Control System Characteristics (Chapters 4, 5, 6, and 7)  
Time Domain Design (Chapters 8 and 9)  
Frequency Domain Design (Chapters 10 and 11)  
State Space Design (Chapter 12)  
Programmable Logic Controllers

**Text:** *Control Systems Engineering*, Nise, zyBooks, 8<sup>th</sup> edition, ISBN 979-8-203-18392-7

To access zyBooks:

1. Sign in or create an account at [learn.zybooks.com](https://learn.zybooks.com)
2. Enter zyBooks code: WKUEE460WilsonFall2023
3. Subscribe

## **References:**

*Modern Control Systems*, Dorf and Bishop, Prentice Hall.  
*Automatic Control Systems*, Kuo and Golnaraghi, Wiley.

## **Class Information:**

- **You are expected to attend all class and lab sessions and will be responsible for material presented during these sessions. It is expected that you are professionals who are capable of understanding the importance of attendance.**
- The class will proceed at a very fast pace. To optimize your learning, it is important that you keep up with the assignments, readings, and labs. The class will build material all semester. Therefore it is important that you keep up with assignments and stay current.
- Remember email can be used as a professional form of communication. The instructor will not respond to unprofessional emails.
- It is perfectly acceptable to ask questions regarding your grades. Discussions about grades will not be conducted via email. Students may schedule an appointment with the instructor to discuss grades if desired.

**Attendance:**

- Attendance will be recorded AT THE BEGINNING of each class and lab session.
- Once attendance has been recorded and class begins, credit will not be given for late arrival.

**Grading:**

The final course average will be determined by multiplying the exam average, final exam, and the assignment average by the weights in the table.

<b>Category</b>	<b>Weight</b>
Assignment Average	50%
Lab Average	10%
Project Average	15%
Exam Average	25%
<b>Total Points</b>	<b>100%</b>

**\*You must earn an average of 60% or higher in each category (exam average, assignment average, lab average, and project average) to earn a C or higher in the class.**

**\*If you do not have an average grade of 60% or higher in each category, the maximum grade you can earn is a D.**

**\* You must earn an average of 70% or higher in each category (exam average, assignment average, lab average, and project average) to earn a grade of A in the class.**

The final course grade\* will be determined according to the following table:

90%	A < 100%
80%	B < 90%
70%	C < 80%
60%	D < 70%
	F < 60%

**Assignments:**

### *Assignment Average*

- The assignment portion of the grade will be composed of homework problems, software labs, and design problems. Each of these assignments will be assigned a point value and the grades will be counted proportionally.
- To calculate your assignment average, add the total possible assignments points and add the number of assignment points earned. Then use the following equation to calculate your assignment average:

$$\text{Assignment average} = 100\% * (\text{assignment points earned}) / (\text{total possible assignment points})$$

### **Lab:**

The lab sessions will begin meeting on Wednesday, August 16 in EST 107. Lab meetings will occur each week during the first half of the semester. The lab average will be determined by the points earned in the lab portion of the class through completion of PLC programs.

### **Project:**

The project will consist of three parts (time domain design, frequency domain design, and state space design). Students will have several weeks to complete the projects. Projects will be penalized for late submission (one letter grade per hour). Work must be neat. Presentation will affect your grade!!!

### *Project Average*

- Each section of the project will be assigned a point value and the grades will be counted proportionally.
- To calculate your project average, use the following equation:

$$\text{Project average} = 100\% * (\text{project points earned}) / (\text{total possible project points})$$

### **Exams:**

- Three one-hour exams and a final exam will be given (Anticipated exam dates: September 15, October 9, November 3) The final exam will be scheduled according to the university final exam schedule on Thursday, December 7, 10:30-12:30

- **No makeup exams will be given.**

- **No early exams will be given.**

- **No late exams will be given.**

- Your exam average will be determined according to the following formula:

- **If the final project score is lower than all four test grades,**  
**exam average = {(exam 1 score) + (exam 2 score) + (exam 3 score) + (final exam)}/4**

- **Otherwise,**  
**exam average = {(final project) + (highest exam score) + (second highest exam 3 score) + (third highest exam score)}/4**

## Guidelines for Submitted Work

- Work must be neat. Presentation will affect your grade!!!
- **No late assignments are accepted!** Students are given adequate time to complete assignments. In order to be successful, it is advised that students use their time wisely. For example, if you are given a week to complete an assignment, this means that the instructor anticipates you will have questions and the assignment will take significant time.
- Students will be instructed on the format of the assignment (hardcopies or Blackboard submissions).
- Assignments submitted on Blackboard must be clear and easy to read. Not all apps/cameras make clear pictures. **Assignments that cannot be read cannot be graded!**
- Assignments to be submitted by Blackboard must be posted according to format provided. **Once you submit an assignment on Blackboard, make sure that it can be clearly read!!!! Not all camera programs produce legible documents!!**
- **DO NOT EMAIL ASSIGNMENTS TO INSTRUCTOR.**
- **ONLY ASSIGNMENTS THAT ARE SUBMITTED ACCORDING TO INSTRUCTIONS WILL BE GRADED!!!!**
- When submitting software assignments, submit the .m file, appropriate graphs labeled with a title, x axis, and y axis. Make sure your work shows the output of the problem. **DO NOT HAND LABEL GRAPHS!!!!** Presentation will affect your grade.

## Academic Misconduct ([Process for Academic Dishonesty | Western Kentucky University \(wku.edu\)](#))

The University expects students to operate with the highest standard of integrity in all facets of the collegiate experience. Broadly defined, academic misconduct is any unethical self-serving action in the performance of an academic activity, deliberate or unintentional, that affords a student an unfair, unearned, or undeserved advantage. (*Excerpt from the WKU Student Handbook, 2016*)

The maintenance of academic integrity is of fundamental importance to the University. Thus it should be clearly understood that acts of plagiarism or any other form of cheating will not be tolerated and that anyone committing such acts will be held accountable for violation of the student code of conduct.

Students who commit any act of academic dishonesty may receive from the instructor a failing grade in that portion of the course work in which the act is detected or a failing grade in a course without possibility of withdrawal. The faculty member may also present the case to the Office of Student Conduct.

Artificial intelligence (AI) tools are not permitted for any type of work in this class. If you choose to use these tools, your actions will be considered academically dishonest and a violation of the [WKU Student Code of Conduct](#).

## Title IX Misconduct/Assault Statement

Western Kentucky University (WKU) is committed to supporting faculty, staff and students by upholding WKU's Title IX Sexual Misconduct/Assault Policy (#0.2070) at <https://wku.edu/eoo/documents/titleix/wkutitleixpolicyandgrievanceprocedure.pdf> and Discrimination and Harassment Policy (#0.2040) at [https://wku.edu/policies/hr\\_policies/2040\\_discrimination\\_harassment\\_policy.pdf](https://wku.edu/policies/hr_policies/2040_discrimination_harassment_policy.pdf).

Under these policies, discrimination, harassment and/or sexual misconduct based on sex/gender are prohibited. If you experience an incident of sex/gender-based discrimination, harassment and/or sexual misconduct, you are encouraged to report it to the Title IX Coordinator, Andrea Anderson, 270-745-5398 or Title IX Investigators, Michael Crowe, 270-745-5429 or Joshua Hayes, 270-745-5121.

Please note that while you may report an incident of sex/gender based discrimination, harassment and/or sexual misconduct to a faculty member, WKU faculty are “Responsible Employees” of the University and **MUST** report what you share to WKU’s Title IX Coordinator or Title IX Investigator. If you would like to speak with someone who may be able to afford you confidentiality, you may contact WKU’s Counseling and Testing Center at 270-745-3159.

### **ADA Accommodation Statement**

In compliance with University policy, students with disabilities who require academic and/or auxiliary accommodations for this course must contact the Student Accessibility Resource Center located in Downing Student Union, 1074. SARC can be reached by phone number at 270-745-5004 [270-745-3030 TTY] or via email at [sarc.connect@wku.edu](mailto:sarc.connect@wku.edu). Please do not request accommodations directly from the professor or instructor without a faculty notification letter (FNL) from The Student Accessibility Resource Center.

### **Ogden Student Course Attendance Statement**

The faculty and staff of Ogden College of Science and Engineering are committed to providing you with learning experiences and opportunities. You must assume ownership of your education and be an active participant in the classroom and laboratory to take advantage of these opportunities. **Active participation requires you to attend.** Scientific studies have shown that attendance during scheduled classroom and laboratory meetings is directly correlated to your performance on assignments and exams and the potential to earn higher grades. Additionally, if you do not regularly attend class, you are missing important information about course topics, due dates, and assignment details that are crucial to your success in the course.

Therefore, as a student enrolled in an Ogden course, you are expected to attend every class meeting and to inform your instructor regarding the reasons for any absences as soon as practical. **Your instructor may incorporate class attendance/participation as part of the grading criteria.**