RICE | MECH
Department of Mechanical Engineering

MECH 488-588 – Design of Mechatronic Systems

M. O'Malley

Spring 2025

Lectures:	Tues/Thurs 2:30 – 3:45 PM, Room HRZ 210 All MECH 488/588 students must complete the OEDK safety quiz: http://oedk.rice.edu/access. Review the safety guidelines and watch the safety video **before** taking the quiz, which can be found here: http://oedk.rice.edu/safetyguidelines.
Instructor:	Marcia K. O'Malley, PhD Thomas Michael Panos Family Professor in Mechanical Engineering
Offices: **Phone:**	MEB 234 and BRC 969 713-348-3545
Email:	omalleym@rice.edu
Office Hours:	TBD *see course Google Calendar for the most up-to-date availability Appointments can be made for in-person or individual office hours, contact instructor via email
Teaching Staff:	*Graduate Student TA's all office in BRC 980* Joshua Fleck jjf8@rice.edu Kyra Stovicek kcs8@rice.edu Elijah Rice er72@rice.edu Jacob Laughlin jl358@rice.edu
Summary:	This course is highly experimental and will touch on a variety of subjects. Active class participation is expected. This course is appropriate for students in Mechanical Engineering, Electrical Engineering, and Bio Engineering. Suggested prerequisites or co-requisites include: • Linear algebra • Ordinary differential equations • Modeling of dynamic systems • Linear control theory • Programming (C++) is helpful
Laboratories:	Laboratories will take place throughout the semester. Students can access MEB 117A or the OEDK for supplies. See Canvas for more details.
Assignments:	**Homework** – There will be little written homework. That does not mean you shouldn't follow examples or do problems from the text on your own. **Laboratories** – Plan on spending a lot of time in the lab. Laboratory deliverables will be assigned in class, and could include fabrication, circuit designs, prototyped circuits, calculations relevant to the laboratory, or computer code. Lab practicals will occur at various intervals, where groups will be required to demonstrate functional systems. **Quizzes** –There will be a mix of in-class and take-home quizzes reinforcing the topics of the course. **Project** – There will be a semester project (details to follow) **Graduate students** – In order to get credit for the graduate version of the course (588), students will be assigned to smaller groups, and additional deliverables will be required.

Reference Texts:	Introduction to Mechatronics and Measurement Systems, David G. Alciatore and Michael B. Histand, Fourth Edition, McGraw Hill, 2011 General undergraduate level textbook on mechatronics. Good for specifics on components, less good for challenges of system integration inherent to mechatronics. Art of Electronics, Horowitz, P. and Hill, W., 3rd Edition, Cambridge University Press, 2015. This reference is strongly recommended if you plan to pursue graduate study in a mechatronics-related area, or if you are a current graduate student in the field. Mechatronics: An Integrated Approach, de Silva, C.W., CRC Press 2004 A comprehensive resource book on modeling, simulation, design, implementation of mechatronic systems, with case studies. Great as a lasting reference for your bookshelf.
Computational Tools:	Students will benefit from having Matlab and Simulink Student Suite with the control systems toolbox. Such tools are also available in campus labs. We will also use C++ in the laboratory portion of the course.
Course Web Site:	Canvas
Required status:	MECH 488 is a technical elective for undergraduates in the mechanics, dynamics, and controls specialization area.

Grading:

Your course grade is determined from the total points you receive from all assignments and quizzes. Borderline grades are determined by class participation.
I indicates an Individual Grade. G indicates a Group Grade.

Lab practicals (G)	50%
Quizzes (I)	25%
Final project (G)	25%

Policies:

- No credit will be given for late assignments unless *previously* approved by the instructor. All assignment submissions will be via Canvas.
- In this course, all students will be held to the standards of the Rice Honor Code, a code that you pledged to honor when you matriculated at this institution. If you are unfamiliar with the details of this code and how it is administered, you should consult the Honor System Handbook at http://honor.rice.edu/honor-system-handbook/. This handbook outlines the University's expectations for the integrity of your academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Quizzes fall under the Rice Honor Code. Individual assignments (specified when assigned) also fall under the Rice Honor Code. Group work can be done in groups, but each group must work independently of other groups. Any use of Chegg is strictly forbidden, regardless of the type of assignment.
- This syllabus is only a guide for the course and is subject to change with reasonable advance notice, as deemed appropriate by the instructor
- You are responsible for all information given in class verbally and/or in writing, and updates posted to Canvas.
- Lab group sizes will be specified in class, and groups may be assigned. There are no formally scheduled lab sessions. Groups may use MEB 117A or the OEDK during open lab hours, or may obtain the key-code or get student ID access for after-hours use.
- After-hours building access can be granted for any enrolled student who needs it.

Course Goals:

- Gain a more complete understanding of basic electrical circuits and electronic devices.
- Learn how to understand and apply semiconductor devices.
- Learn the basics of digital electronics.
- Learn the theoretical and practical aspects of measurement system design.
- Learn the basics of sensor and actuator theory, design, and application.
- Become proficient with using laboratory instrumentation and with building basic circuits.
- Gain experience designing and assembling basic mechatronic systems.

Course Topics: (Items in *italics* may be covered if time permits)

Electronics

- Analog circuit elements
- Filtering
- Avoiding noise
- Schematics
- Power electronics
- Signal electronics

Sensors and Actuators

- DC motors
- *Piezoelectric actuators*
- *Voice coil actuators*
- *Stepper motors*
- Potentiometers
- *LVDT's*
- Strain gages
- *Resolvers*
- *Position sensing diodes*
- Hall effect transducers
- *Inductive and capacitive position sensing*
- *Accelerometers*

Analog Control

- State space feedback methods
- Classical control methods

Digitally-implemented control

- Introduction to digital control
- A/D and D/A conversion
- Computer control via C, LabVIEW, and/or Simulink

Any student with a disability requiring accommodation in this course is encouraged to contact the instructor after class or during office hours.

Rice University cares about your wellbeing and safety. Rice encourages any student who has experienced an incident of harassment, pregnancy discrimination, gender discrimination, or relationship, sexual, or other forms interpersonal violence to seek support through The SAFE Office. Students should be aware when seeking support on campus that most employees, including myself, as the instructor, or TA/graders, are required by Title IX to disclose all incidents of non-consensual interpersonal behaviors to Title IX professionals on campus who can act to support that student and meet their needs. For more information, please visit safe.rice.edu. or email titleixsupport@rice.edu.