MECA380: Measurements and Instrumentation
Fall 2022

Instructor: Stewart Lamon
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Office: OCNL 416
Office Hours: Tuesday 1-3
            Wednesday 2-3
            Thursday 12-1

Sections: Discussion Sections (OCNL 124):
          01: Monday and Friday, 4-4:50PM

Laboratory Sections (PLMS 112):
01: Tuesday, 5-7:50 PM
02: Wednesday, 5-7:50 PM
03: Thursday, 2-4:50PM

Course Description and Goals
Measurement of steady-state and dynamic systems using standard laboratory instruments. Topics include calibration and dynamic response of instruments, statistical treatment of data, and applied feedback control systems. Concepts are reinforced with hands-on laboratory exercises.

Prerequisites
EECE 211/211L (Linear Circuits) plus, one of the following: CSCI 111 (Programming and Algorithms), MECH 208 (Introduction to Technical Computing), or AMAR 300 (Applied Mathematics and Programming for Advanced Manufacturing).

Student Learning Objectives
After completion of this course, students will be able to:

• Measure resistance, temperature, acoustic, strain and other measurements using common laboratory and data acquisition instruments, including development of virtual instruments in LabVIEW.
• Analyze characteristics of, design, and calibrate measurement systems consisting of sensors, transducers, signal conditioning, data acquisition, and output stages.
• Conduct experiments implementing methods to reduce errors from noise and interference, apply statistical treatment, analyze, and interpret data.
• Apply signal conditioning techniques to improve measurement quality focusing on excitation signals, amplification/attenuation, buffering, filtering, linearization, scaling, and additional application-specific methods.
• Evaluate signals in the frequency domain, including optimization of sampling frequencies to avoid aliasing and other measurement errors.
• Gain understanding of common noise and mitigation strategies to reduce measurement errors from common sources intrinsic and extrinsic noise.
• Calculate instrument uncertainty and apply strategies to design instruments with sufficient accuracy for any given application.
• Write convincing technical reports and instrument specification sheets.

Core Knowledge Development
Throughout this course, students are expected to acquire core knowledge in:

• Basic Concepts of Measurement and Measurement Instruments
• Sensors and Characteristics of Sensors
• Calibration Errors and Methods to Minimize
• Experiment Design
• Temperature Measurements
• LabVIEW Fundamentals
• Application of Probability and Statistics to Measurement
• Regression, Correlation and Causation, and Correlation Coefficients
• Characterizing 1st and 2nd Order Systems
• Electrical Measurements and Basic Lab Instrumentation
• Signal Conditioning Fundamentals
• Filtering Methods
• Scaling and Linearization
• Frequency Domain and Basic Spectral Analysis
• Aliasing and Sampling Considerations
• Analog-to-Digital and Digital-to-Analog Conversions
• Strain Measurements
• Sources of Electrical Noise & Mitigation Strategies
• Determining Instrument Uncertainty

Course Usage of Blackboard Learn
Copies of the course syllabus, all assignments, schedule, and due dates can be found on Blackboard Learn. You are responsible for regularly checking Blackboard for updates and announcements, which can be accessed through the Chico State Portal.

Classroom Etiquette and Attendance
During classroom sessions, students are expected to be completely engaged and committed to the class (no personal web surfing, messaging, social media, etc.). Attendance is required and students will receive credit for active and engaged participation in the course. If you are unable to attend a class due to an emergency or any other reason, please notify the instructor promptly (before class if possible).
Dropping and Adding
You are responsible for understanding the policies and procedures about add/drops, academic renewal, etc., found in the CSU Chico University Catalog. You should be aware of the new deadlines and penalties for adding and dropping classes.

Lab Notebooks
You will need a bound lab notebook for laboratory section of the course. This will be reviewed during lab sections and turned in at the end of the course. More details will be discussed in class.

Grading Policy
- 20% Attendance, Conduct, Participation, and Quizzes
- 40% Lab Reports and Assignments
- 40% Exams (Curved)

A ≥ 93% > A- ≥ 90% > B+ ≥ 87% > B ≥ 83% > B- ≥ 80% > C+ ≥ 77% > C ≥ 73%
73% > C- ≥ 70% > D ≥ 60% > F

Late Assignments
Late assignments will lose 10% of the full credit for each day they are late up for up to a week, after which it will not be accepted excepting extenuating circumstances.

Equipment / Textbooks / Additional Resources

Computer and Software (Required)
You are required to have a PC-based laptop capable of running LabVIEW’s NI ELVISmx Software Suite 2019 (a student software license will be provided to you for the duration of this course). You will need to bring your laptop to all lab sections. MATLAB and/or Excel are also highly recommended software for this course.

Course Textbook (Required)

Supplemental Textbook (Optional)

Recommended book for learning LabVIEW (Optional)
I would recommend this book for anyone interested in learning LabVIEW in greater detail.
Recommended book for electronics (Optional)
I would recommend this book for all mechatronics majors and anyone interested in building mechatronics systems.

University Policies and Campus Resources

University Policy Regarding COVID-19 Safety

On-Campus Spaces for Attending Online Classes (Optional)
For students who have a mix of online and in-person classes, the University has prepared spaces for students to attend classes on-campus. The closest options to our classrooms include Meriam Library (MLIB), Bell Memorial Union (BMU), and the Science Building (SCI), more information can be found here: Student Learn Space Locations.

Academic Integrity
Students are expected to be familiar with the University’s Academic Integrity Policy. Your own commitment to learning, as evidenced by your enrollment at California State University, Chico, and the University's Academic Integrity Policy requires you to be honest in all your academic coursework. Faculty members are required to report all infractions to the Office of Student Judicial Affairs. The policy on academic integrity and other resources related to student conduct can be found on the Student Judicial Affairs website.

IT Support Services (Optional)
Computer labs for student use are located on the first and fourth floor of the Meriam Library, Room 116 and 450, Tehama Hall Room 131, and the Bell Memorial Union (BMU) basement. You can get help using your computer from IT Support Services; contact them through the ITSS web site. Additional labs may be available to students in your department or college.

Student Services (Optional)
Student services are designed to assist students in the development of their full academic potential and to motivate them to become self-directed learners. Students can find support for services such as skills assessment, individual or group tutorials, subject advising, learning assistance, summer academic preparation and basic skills development. Student services information can be found on the current students page of the CSU Chico web site.

Americans with Disabilities Act
If you need course adaptations or accommodations because of a disability or chronic illness, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Please also contact Accessibility Resource Center (ARC) as they are the designated department responsible for approving and coordinating reasonable accommodations and services for students with disabilities. ARC will help you understand your rights and
responsibilities under the Americans with Disabilities Act and provide you further assistance with requesting and arranging accommodations.

**Accessibility Resource Center**
530-898-5959
Student Services Center 170 arcdept@csuchico.edu

**Student Learning Center (Optional)**
The mission of the Student Learning Center (SLC) is to provide services that will assist CSU, Chico students to become independent learners. The SLC prepares and supports students in their college course work by offering a variety of programs and resources to meet student needs. The SLC facilitates the academic transition and retention of students from high schools and community colleges by providing study strategy information, content subject tutoring, and supplemental instruction. The University Writing Center has been combined with the Student Learning Center. You can also visit the [Student Learning Center web site](https://www.csuchico.edu/student-learning-center).

**Blackboard ALLY**
Chico State is committed to providing you the best learning experience possible. With this goal we have activated Blackboard ALLY in your courses. ALLY is a revolutionary product that focuses on making digital course content more accessible to all students. You will now be able to download any content in this course in the format that fits best with your learning style. PDF, HTML, .EPUB and Audio files are now available for most content items. Here is a link to more information on formats available as well as what each format offers. Should you have any questions or experience issues while using ALLY please contact the Office of Accessible Technology and Services at oats@csuchico.edu or 530-898-6532.