MECH 2510 & MECH 2515

For additional course information, including prerequisites, corequisites, and course fees, please refer to the Catalog: https://catalog.uvu.edu/

Semester: Fall
Course Prefix: MECH
Year: 2026
Course Title: Fundamentals of Automation Controls (2510) and Laboratory (2515)

Course and Section #: 2510-X01, 2510-X02, 2515-202, 2515-801

Credits: 2.0 (MECH 2510) and 1.0 (MECH 2515)

Course	Section	CRN	Credits	Meets	Location
MECH 2510	X01	26345	2	Asynchronous	Online
MECH 2510	X02	41693	2	Asynchronous	Online
MECH 2515	202	39283	1	Mon/Wed 9:00–10:15 a.m.	GT 517
MECH 2515	801	41695	1	Tue/Thu 5:00–6:15 p.m.	GT 517

Term: 19 August – 4 December 2026. Final exams: 7–11 December 2026. MECH 2510 and MECH 2515 are corequisites and are taught together; this syllabus covers both.

Course Description

MECH 2510 — Fundamentals of Automation Controls (2 credits)
Covers how to select, install, and troubleshoot sensors in a manufacturing environment. Emphasizes the application of proximity sensors in automation equipment as well as the use of encoders to measure speed and position, pressure transducers, and the use of thermocouples and thermistors to measure temperature. Covers signal conditioning methods to interface sensors to microprocessors and PLCs. Introduces smart sensors and safety-related sensor applications in automation systems. Provides a foundational overview of servo and stepper motor feedback integration and introduces the role of variable speed drives (VSDs) and basic industrial Ethernet communication.

MECH 2515 — Fundamentals of Automation Controls Laboratory (1 credit)
Applies methods for proper selection, installation, and troubleshooting of sensors in a manufacturing environment. Emphasizes the application of proximity sensors in automation equipment as well as the use of encoders to measure speed and position, pressure transducers, and the use of thermocouples and thermistors to measure temperature. Utilizes signal conditioning methods to interface sensors to microprocessors and PLCs. Introduces smart sensors and their role in safety-related automation systems. Introduces industrial Ethernet-based communication for sensor integration and basic IIoT connectivity.

Course Attributes

This course has the following attributes:
☐ General Education Requirements
☐ Global/Intercultural Graduation Requirements
☐ Writing Enriched Graduation Requirements

☒ Discipline Core Requirements in Program
☐ Elective Core Requirements in Program
☐ Open Elective
Other: MECH 2510 and MECH 2515 are corequisites and must be taken together.

Instructor Information

Instructor Name: Tim HakalaTim Hakala
Email: thakala@uvu.edu
Office: GT 619A
Office Hours: Mon/Wed 10:30 a.m.–12:00 p.m. and Tue/Thu 6:15–7:15 p.m., held in GT 517 immediately following each lab block. Outside those windows, find me in GT 619A.
MECH 2510 and MECH 2515 are corequisites, so every student in the lecture course is also in a lab section and on campus twice a week — these hours reach everyone. If neither window works, email me and we will find a time.

Student Learning Outcomes

MECH 2510 — upon successful completion, students should be able to:

1. Select an appropriate sensor for a stated industrial measurement task and justify the choice from datasheet specifications, including range, resolution, accuracy, repeatability, response time, and environmental rating.
2. Explain the operating principle of inductive, capacitive, photoelectric, and ultrasonic proximity sensors, and predict which target materials and conditions will cause each to fail.
3. Determine a sensor's output type — PNP or NPN, discrete or analog, two-, three-, or four-wire — from its part number and datasheet, and specify correct interfacing to a PLC or microprocessor input.
4. Apply signal conditioning methods — amplification, filtering, cold-junction compensation, linearization, and analog-to-digital conversion — to make a raw sensor output usable by a controller.
5. Calculate speed and position from incremental encoder output, accounting for pulses per revolution, counting mode, and resulting resolution.
6. Describe the role of smart sensors and IO-Link in providing diagnostic and process data beyond a simple measured value.
7. Describe the function of safety-rated sensing devices and explain why they are architecturally distinct from standard sensors.
8. Describe how variable speed drives and industrial Ethernet protocols are applied in industrial control settings.

MECH 2515 — upon successful completion, students should be able to:

1. Install, align, and adjust proximity and photoelectric sensors, and verify operation against the manufacturer's specified sensing distance.
2. Wire both PNP and NPN discrete sensors correctly to PLC inputs, and recognize the failure signature of a sourcing/sinking mismatch.
3. Calibrate and scale an analog sensor — pressure transducer, RTD, or thermocouple — into engineering units, and quantify the resulting measurement error.

4. Measure rotational speed and angular position using an incremental encoder.
5. Diagnose a non-functioning sensor circuit using a multimeter and a systematic troubleshooting procedure, isolating the fault to supply, sensor, wiring, or input card.
6. Document lab work to industry standard, including exact part numbers, wiring records, and calibration data sufficient for another technician to reproduce the result.

Course Materials and Texts

No textbook purchase is required at this time. Candidate texts are still under review, and assigned readings are provided in Canvas at no cost. If a text is adopted later in the semester, you will be given notice well before anything is required of you — do not buy a book on speculation.

Among the titles under consideration: Instrumentation and Control Systems, William Bolton, 3rd ed., Elsevier/Newnes, 2021 — it matches the sensor, transducer, and signal-conditioning core of these courses. No decision has been made.

https://www.amazon.com/Instrumentation-Control-Systems-William-Bolton/dp/0128234717

The previously used text — Bartelt, Industrial Control Electronics, 3rd ed. (2005) — is out of print and has no newer edition.

Supplemental references, manufacturer datasheets, and application notes will be posted in Canvas and are free. You are expected to read manufacturer datasheets in this course — that is the actual literature of the trade.

Course Requirements

Course Assignments, Assessments, and Grading Policy

Grade Weights

MECH 2510 — lecture, 2 credits

Weekly quizzes and assignments	80%
Final exam	20%

The two lowest scores in the quizzes-and-assignments category are dropped at the end of the semester. Every item in that category carries the same point value; a larger assignment may be entered as two equally weighted parts.

MECH 2515 — laboratory, 1 credit

Lab assignments	100%

Every lab is scored on the same rubric:

Lab sheet — steps documented, check-offs, cleanup	50%
Debrief — the written questions	50%

Cleanup is scored per station; all students working at a station receive the same cleanup score, except that a student who leaves before the area is released may be scored zero individually.

The two lowest lab scores are dropped at the end of the semester.

MECH 2510 and MECH 2515 are graded separately and carry separate grades.

Grade Scale

Grade	Percent Cumulative Score
A	92 – 100.00
A-	89 – 91.99
B+	86 – 88.99
B	83 – 85.99
B-	80 – 82.99
C+	77 – 79.99
C	74 – 76.99
C-	71 – 73.99
D+	68 – 70.99
D	65 – 67.99
D-	62 – 64.99
E	0 – 61.99

Late Work

Work is due at the posted deadline. Late work is accepted **only** when an exception for unusual circumstances has been cleared with the instructor **in advance**. There is no automatic late-penalty lane and no blanket extension — work that is simply late, with nothing arranged beforehand, is not accepted.

Work covered by such an exception must still be submitted **within one week** of its original deadline; Canvas closes submission at that point. The only exceptions to the one-week limit are a University-approved accommodation arranged through Accessibility Services and an approved religious accommodation.

In the laboratory, only the written portion of a lab may be submitted late. Check-offs and cleanup of the work area are earned during the scheduled session and cannot be made up.

Laboratory Attendance

Lab attendance is required. The laboratory is hands-on and equipment-dependent — six stations and limited spares — so a session cannot be repeated outside its scheduled block, and there are no make-up labs. MECH 2510 is asynchronous and has no attendance requirement.

You do not need to explain an absence. Your two lowest lab scores are dropped automatically at the end of the semester, and a missed lab is a zero that may be one of those two. That allowance covers illness, car trouble, work conflicts, and bad days — combined. It is the only flexibility built into the lab grade. A third missed lab is a zero that stays.

Safety instruction given at the start of a session is mandatory; a student who misses it may not work at a bench that day.

Required or Recommended Reading Assignments

Reading assignments will be posted each week in Canvas and will focus on assigned chapters, sections, and manufacturer datasheets. Supplemental references, online or otherwise, are optional.

General Description of the Subject Matter of Each Lecture or Discussion

Lectures align with the course learning outcomes. Case studies, industry examples, and current events pertaining to safety or technology advances may also be included. Key topics are:

- Sensor taxonomy and operating principles; matching a sensing technology to a target material and environment
- Reading a datasheet: range, resolution, accuracy, repeatability, hysteresis, response time, IP rating
- Inductive and capacitive proximity sensing, including correction factors for target material
- Photoelectric sensing modes: through-beam, retroreflective, diffuse, background suppression
- Ultrasonic sensing for distance and level measurement
- Discrete output structures: PNP versus NPN, sourcing versus sinking, two-, three-, and four-wire wiring
- Interfacing discrete sensors to PLC inputs; debouncing and input filtering
- Temperature measurement with thermocouples, RTDs, and thermistors; cold-junction compensation and linearization
- Pressure transducers and the 4–20 mA current loop; why current loops resist noise and detect broken wires
- Analog signal conditioning: amplification, filtering, isolation, and analog-to-digital conversion
- Scaling raw counts to engineering units, and quantifying the resulting measurement error
- Incremental encoders: pulses per revolution, quadrature, counting modes, index pulse, speed and position calculation
- Servo and stepper motor feedback integration
- Variable speed drives and their role in a sensor-driven control architecture
- Smart sensors and IO-Link: diagnostics, parameterization, and process data beyond a single measured value
- Safety-related sensing: light curtains, safety relays, and why safety architecture differs from standard control
- Industrial Ethernet fundamentals and basic IIoT connectivity for sensor integration
- Systematic troubleshooting of sensor circuits in a manufacturing environment

Required Course Syllabus Statements

Generative AI

AI tools are welcome in this course for research given the following conditions and restrictions.

Permitted uses: Research, drafting, debugging, or refining your work.

Any AI output requires your careful review, evaluation, and verification. You must cite any use of AI. Final submissions must reflect your own personal understanding, whether or not using AI.

Mandatory attribution: You must include a note for every use of AI (e.g. "ChatGPT 4o was used for outline refinement") that is obvious, clear, and directly attached to your submitted work.

Prohibited: You are not allowed to include AI-generated content for any work that is represented as 100% your own; when any part of your work is modified by AI, you are forbidden from claiming the work as 100% your own. You must include a written note of attribution (citation) for every use of AI.

Responsibility: You remain accountable for accuracy, proper citations, and compliance with UVU academic-integrity policies.

Using Remote Testing Software

☒ This course does not use remote testing software.

☐ This course uses remote testing software. Remote test-takers may choose their remote testing locations. Please note, however, that the testing software used for this may conduct a brief scan of remote test-takers' immediate surroundings, may require use of a webcam while taking an exam, may require the microphone be on while taking an exam, or may require other practices to confirm academic honesty. Test-takers therefore shall have no expectation of privacy in their test-taking location during, or immediately preceding, remote testing. If a student strongly objects to using test-taking software, the student should contact the instructor at the beginning of the semester to determine whether alternative testing arrangements are feasible. Alternatives are not guaranteed.

Required University Syllabus Statements

Accommodations/Students with Disabilities

Students needing accommodations due to a permanent or temporary disability, pregnancy or pregnancy-related conditions may contact UVU Accessibility Services at accessibilityservices@uvu.edu or 801-863-8747.

Accessibility Services is located on the Orem Campus in BA 110.

Deaf/Hard of Hearing students requesting ASL interpreters or transcribers can contact Accessibility Services to set up accommodations. Deaf/Hard of Hearing services can be contacted at DHHservices@uvu.edu

DHH is located on the Orem Campus in BA 112.

Academic Integrity

At Utah Valley University, faculty and students operate in an atmosphere of mutual trust. Maintaining an atmosphere of academic integrity allows for free exchange of ideas and enables all members of the community to achieve their highest potential. Our goal is to foster an intellectual atmosphere that produces scholars of integrity and imaginative thought. In all academic work, the ideas and contributions

of others must be appropriately acknowledged and UVU students are expected to produce their own original academic work.

Faculty and students share the responsibility of ensuring the honesty and fairness of the intellectual environment at UVU. Students have a responsibility to promote academic integrity at the university by not participating in or facilitating others' participation in any act of academic dishonesty. As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, assessments, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Likewise, instructors are responsible to clearly state expectations and model best practices.

Further information on what constitutes academic dishonesty is detailed in UVU Policy 541: *Student Code of Conduct*.

Equity and Title IX

Utah Valley University does not discriminate on the basis of race, color, religion, national origin, sex, sexual orientation, gender identity, gender expression, age (40 and over), disability, veteran status, pregnancy, childbirth, or pregnancy-related conditions, citizenship, genetic information, or other basis protected by applicable law, including Title IX and 34 C.F.R. Part 106, in employment, treatment, admission, access to educational programs and activities, or other University benefits or services. Inquiries about nondiscrimination at UVU may be directed to the U.S. Department of Education's Office for Civil Rights or UVU's Title IX Coordinator at 801-863-7999 – TitleIX@uvu.edu – 800 W University Pkwy, Orem, 84058, Suite BA 203.

Religious Accommodation

UVU values and acknowledges the array of worldviews, faiths, and religions represented in our student body, and as such provides supportive accommodations for students. Religious belief or conscience broadly includes religious, non-religious, theistic, or non-theistic moral or ethical beliefs as well as participation in religious holidays, observances, or activities. Accommodations may include scheduling or due-date modifications or make-up assignments for missed class work.
To seek a religious accommodation, a student must provide written notice to the instructor and the Director of Accessibility Services at accessibilityservices@uvu.edu. If the accommodation relates to a scheduling conflict, the notice should include the date, time, and brief description of the difficulty posed by the conflict. Such requests should be made as soon as the student is aware of the prospective scheduling conflict.

While religious expression is welcome throughout campus, UVU also has a specially dedicated space for meditation, prayer, reflection, or other forms of religious expression.