Cincinnati State

EMET 180 – Process Instrumentation

Spring 2019

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Feel free to visit me during my office hours or by appointment.
Please contact the CIT office receptionist to schedule a meeting at (513) 569-1743.

Course Description

In this course the student will learn the fundamentals of "process instrumentation theory and applications. Topics include: principles and practices of measurement and control of temperature, pressure, flow, level, and analytical quantities; and data acquisition for process instruments and controls".

Prerequisites

EET 131, EMET 140 ***OR*** *EMET 150*

Required Texts/Supplements

Course material will be provided by the instructor primarily online via Blackboard. Students are encouraged to compile information in a 3-ring binder and/or electronically.

Digital Trainer Kit (*optional*)

Course Outcomes

After completing this course the student will be able to

1. Describe the fundamentals of process control.
2. Implement closed-loop negative feedback control.
3. Tune a Proportional-Integral-Derivative (PID) controller.
4. Select appropriate temperature, proximity, force, and flow sensors.
5. Describe industry standard signals and signal conditioning methods.
6. Utilize computer data acquisition and perform transducer calibration.

Course Grading

The course grade will be determined by scores on several homework assignments, hands-on labs, and two (2) written exams. The distribution of final grade points including class participation will be roughly as follows:

Hands-on Labs	45%
Assignments	25%
Examinations	25%
Participation/attendance*	5%

*The participation/attendance points are a subjective measure of the student's attendance, participation, and improvement. The points typically improve the grade assigned when on the threshold between letter grades.

The final letter grade for the course is based on the traditional ten point scale.

- A = 90% or above "Superior"
- B = 80-89% "Good"
- C = 70-79% "Average"
- D = 60-69% "Poor"
- F = below 60% "Failure"

Labs, Assignments & Exams

There will be numerous laboratory assignments throughout the course. The labs will be completed individually or in small groups as announced in class.

There will also be some homework assignments in the course. Lecture notes, textbook readings, and classroom activities can be used as a study guide.

There will be two (2) written exams. The exams will generally cover material from the immediately preceding topics. Exam content will be discussed in class prior to the exam date.

Attendance & Classroom Decorum

Attendance is required. The student is expected to attend and participate in every class session and is responsible for completing all assignments on time. It is understood some absences are unavoidable and that missing class hampers the student's ability to learn course material. A penalty will be assessed against your final grade for excessive unexcused absences through a reduction in attendance points. *If you miss more than two (2) weeks class time equivalent, you will fail the class.*

Please refrain from using cell phones and media devices during class periods. E-smoking is not permitted while class is in session. For rooms equipped with workstation computers, the computers are not to be used during lectures unless authorized by the

instructor. *Texting in class will not be tolerated. You may step outside of the classroom if necessary.*

For class periods longer than two (2) hours, breaks for free time will be given as necessary.

Teaching Philosophy

My teaching philosophy is simple. I aim to *educate* the individual, and not to merely *train* the individual, using a blend of theory and practice.

Training often focuses on specific tasks necessary to meet specific ends under specific conditions. On the other hand, education focuses on knowing the reasons for the specific tasks such that ends can be met under a variety of conditions.

With education comes the ability to respond to new problems more quickly and effectively. A key element of education is exploring the answers to the underlying questions of what, why, and how. That is, the "theory".

Knowing the theory, however, is only half the equation. For engineering technologists, hand skill is uniquely important for putting theory into practice. Individuals who implement solutions to problems using the proper tools, and with quality workmanship, generally have more opportunity.

Student Learning Focus

Education is a personalized journey that requires reflection and study. Please allow sufficient time to review concepts before and after class. It is also important to identify how you learn best so that lessons may be presented more effectively if possible.

Critical thinking and troubleshooting are "money-makers" in the engineering world. Armed with an understanding of the root causes of problems in systems, troubleshooting is a skill much easier to master.

Importantly, technical language and communication are keys to success. Vocabulary exists so that complete and accurate ideas can be shared efficiently. As I learned from a mentor long ago, it is best to say what you *mean*, and not what you *meant*.

Student Responsibility

Students are responsible for material that may be assigned on this syllabus as well as *additional information announced in class*. The instructor will not rely exclusively on material from the textbook(s).

Good note taking is highly encouraged and helps makes learning successful. Often class sessions are conversational in nature with much of the information presented orally.

Students are advised to capture key ideas and instructions on paper as formal notes will generally not be presented on the board.

Students are expected to complete all assignments on time. Assignments may be submitted online through Blackboard, collected in class on paper, demonstrated using lab equipment, or through other means. *Late work will be penalized 5% per day up to seven (7) days, after which a grade of 0% will be recorded.*

E-mail Communication

Electronic-mail (e-mail) is a valuable communication tool and especially useful in distance learning and online education programs. The ease of sending e-mail however has encouraged the loss of writing etiquette and social courtesy. Good message composition has given way to fragments and absent punctuation. I encourage students to read *E-Mail Etiquette: The Do's and Don'ts* in hardcopy or online. *At a minimum, when sending e-mail messages please include in the subject line the class number and section. And, in the body, open with a greeting and close with a salutation including your name.*

The instructor will only correspond via email using your Cincinnati State account. It is mandatory that this account be checked at least once daily.

Academic Integrity

Please maintain academic integrity in this and all classes as academic dishonesty of any type will not be tolerated. Refer to the Academic Integrity Policy of the current college catalog for information, available online at http://www.cincinnatistate.edu/real-world-academics/catalogs/. All work submitted in class not original to the student must be cited. This includes text, graphics, images, and the like. ***No excuses.***

Special Needs

Students with disabilities may register with the Office of Disabilities Services and present proper paperwork to the instructor in the first week of classes so that special arrangements may be made. The goal is to ensure students have an equal opportunity to pursue their educational objectives.

You may contact the office by phone at (513) 569-1775 or in person in room Main 129.

Tutoring Services

The College provides free individual or group tutoring. Students may request a tutor through the Success Center. Walk-in help is available. The approximate hours for the Success Center are Monday through Thursday from 9am to 8pm, Friday from 9am to 4pm, and Saturday from 9am to 3pm in Main 261.

Course Content

The course content and assignments will be announced weekly in class or on Blackboard. *Check the Blackboard class site often for assignment details, due dates, and relevant announcements.*

Note: The weekly activities may change. *Check Blackboard often for due dates and announcements.*

Week	Lecture Topics	Assignment(s)
1	Introduction and overview – sensors, transducers, measurement, control, and data acquisition	Lab 1 – Simple Temperature Monitor Guide to Breadboarding
2	Temperature sensors, thermometers, and scales; Peltier & Seebeck effects	Lab 2a – Electronic Thermometer Build Assignment 1 – Intro to Thermometry
3	Signal types, signal conditioning, and calibration; Non-contact thermometry	Lab 2b – Electronic Thermometer Calibration Assignment 2 – IR Thermometry
4	Computer-based data acquisition, digital oscilloscope; Current loop measurements	Lab 3 – Introduction to Data Acquisition Assignment 3 – Resolution,Accuracy,Precision
5	Proximity sensing, contact vs. non-contact, standard output types, hysteresis; “sinking” vs. “sourcing”	Lab 4 – Current Loop Measurement Lab 5 – Inductive Proximity Sensors
6	Inductive proximity sensor applications; Capacitive proximity sensors	Lab 6 – Shaft Speed Sensing Lab 7 – Capacitive Proximity Sensor
7	Wheatstone bridge, signal conditioning review	EXAM 1
8	Process control fundamentals, on-off and 3-term controller (PID); “Breadboard Furnace” application	Lab 9 – Breadboard Furnace Physical Plant Lab 10 – Breadboard Furnace On-Off Control
9	Proportional and integral control concepts	Lab 10.5 – Bb Furnace Proportional Control Assignment 4 – PID Process Controller
10	Photoelectric proximity and process sensors and applications; Optical isolation	Lab 11 – Photoelectric Sensors
11	Ultrasonic proximity sensor; Process sensors and applications	Lab 12 – Ultrasonic Sensor Lab 8 – Capacitive Process Sensor
12	Introduction to encoders (rotary/linear, absolute/incremental, quadrature)	Lab 13 – Incremental Encoder Investigation
13	Magnetostrictive effect for distance measurement	Lab 14 – Magnetostrictive LDT
14	Strain gauge force measurement and applications (mass scale, torque/pressure transducers)	Lab 15 – Strain Gauge Investigation
15	Process & Instrumentation Diagrams (P&ID)	Assignment 5 – Process Automation Example EXAM 2