

Fundamentals of Measurement and Process Control (INCR 1442)



Credit: 4 semester credit hours (3 hours lecture, 4 hours lab)

Prerequisite/Co-requisite: INCR 1402 and CETT 1405

Course Description

A study of the basic principles of process automation and their applications including basic control concepts, feedback control, sensors and transmission systems, controllers, control valves, process dynamics, tuning control systems, and cascade ratio.

Required Textbook and Materials

1. *Instrumentation 5th Edition* by Franklyn W. Kirk, Thomas A Weedon, and Philip Kirk, American Technical Publishers
 - a. ISBN number is 978-082-693-43-07
2. Scientific Calculator
3. Notebook

Course Objectives

Upon completion of this course, the student will be able to:

1. Demonstrate an understanding of process dynamics. (Scans C 5.5, C 6.3, C 7.5, C 10.2, C 12.3, C 14.3, C 15.5, C 19.4, F 1.5, F 5.5, F 10.5, F 11.5, F 12.5)
2. Illustrate basic control concepts. (Scans C 5.5, C 6.3, C 7.5, C 15.5, C 16.3, C 19.5, F 1.5, F 2.3, F 3.3, F 4.3, F 5.5, F 9.3, F 10.5, F 11.5, F 12.5)
3. Tune control systems (Scans C 5.5, C 6.3, C 8.3, C 15.3, C 16.3, C 18.3, C 19.3, C 20.3, F 4.5, F 8.5, F 9.5, F 10.5, F 11.5, C 12.5)

SCANS Skills and Competencies

Beginning in the late 1980's, the U.S. Department of Labor Secretary's Commission on Achieving Necessary Skills (SCANS) conducted extensive research and interviews with business owners, union leaders, supervisors, and laborers in a wide variety of work settings to determine what knowledge workers needed in order to perform well on a job. In 1991 the Commission announced its findings in *What Work Requires in Schools*. In its research, the Commission determined that "workplace know-how" consists of two elements: foundation skills and workplace competencies.

Course Outline

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|---|---|
| A. Introduction <ol style="list-style-type: none">1. Introduction of faculty and students2. Review Syllabus3. Review Class Policies4. Review Lab Assignment | B. Automatic Control <ol style="list-style-type: none">1. Process Dynamics2. Control Functions3. Control Strategies4. Controller Tuning |
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Course Syllabus

- 5. Digital Controllers
- 6. Pneumatic Controllers
- 7. Electric Controllers
- 8. Operator Interfaces
- 9. Configuration Formats
- 10. Advanced Control Strategies
- C. Final Elements
 - 1. Control Valves
 - 2. Regulators
 - 3. Dampers
 - 4. Actuators and Positioners
 - 5. On/Off Control Actions
 - 6. Variable-Speed Drives
 - 7. Electric Power Controllers
- D. Safety Systems
 - 1. Safety Systems
 - 2. Individual Safety Devices
 - 3. Hazardous Atmosphere Detectors
 - 4. Electrical Safety Standards
 - 5. Safety Instrumented Systems
- E. Applications
 - 1. Instrument Applications
 - 2. General Techniques
 - 3. Temperature
 - 4. Pressure
 - 5. Level
 - 6. Flow
 - 7. Analysis
 - 8. Multivariable

Grade Scale

90 – 100	A
80 – 89	B
70 – 79	C
60 – 69	D
0 – 59	F

Course Evaluation

Final grades will be calculated according to the following criteria:

Activity	Percentage
Homework/Labs	10%
Quizzes	10%
Major Test	50%
Final	30%
Total	100%

Course Requirements

- 1. Develop understanding of Process Dynamics.
- 2. Operate a Smart Communicator.
- 3. Use a Smart Communicator to calibrate a Smart Transmitter.
- 4. Configure a Digital Controller.
- 5. Configure a Digital Recorder.
- 6. Wire an instrument loop with a transmitter, controller and digital recorder.
- 7. Operate the Instrument Loop on manual and automatic.
- 8. Tune the controller using Gain, Integral, and Derivative.

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Course Syllabus

Attendance Policy

1. Missing more than 20% of classes will result in an automatic “F” for the course.
2. Absences are counted for unexcused, excused and coming to class late.
3. Missing more than 20% of a class period will count as an absence.
4. Being tardy 3 times equals 1 absence.

Course Policies

1. No food, drinks, or use of tobacco products in class.
2. No foul or harsh language will be tolerated
3. Turn off all Cell Phones during lectures
4. Headphones may be worn only upon Instructor approval
5. Do not bring children to class.
6. No Cheating of any kind will be tolerated. Students caught cheating or helping someone to cheat can and will be removed from the class for the semester. Cheating can result from expulsion from LIT.
7. If you wish to drop a course, the student is responsible for initiating and completing the drop process. If you stop coming to class and fail to drop the course, you will earn an ‘F’ in the course.

Disabilities Statement

The Americans with Disabilities Act of 1992 and Section 504 of the Rehabilitation Act of 1973 are federal anti-discrimination statutes that provide comprehensive civil rights for persons with disabilities. Among other things, these statutes require that all students with documented disabilities be guaranteed a learning environment that provides for reasonable accommodations for their disabilities. If you believe you have a disability requiring an accommodation, please contact the Special Populations Coordinator at (409) 880-1737 or visit the office in Student Services, Cecil Beeson Building.

Course Schedule

Week	Topic	Reference
1	Course introduction, policies and Lab panels <ul style="list-style-type: none">• Lecture• Lab: Layout of Lab panels	Handouts
2	Automatic Control and Process Dynamics <ul style="list-style-type: none">• Lecture• Lab: Sketch the Lab panel assigned and become familiar with equipment	Chapter 35
3/4	Control Functions <ul style="list-style-type: none">• Lecture• Lab: Describe in detail four common control strategies and workbook	Chapter 36

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Course Syllabus

Week	Topic	Reference
	exercises. • Test 1	
5/6	Controller Tuning • Lecture • Lab: Tuning coefficients and Performance Standards and Workbook exercises.	Chapter 37
7	Digital Controllers • Lecture • Lab: Configure a Digital Controller.	Chapter 37
8	Pneumatic/ Electric Controllers • Lecture • Lab: Chapter and workbook Exercises	Chapter 38
9	Configuration Formats • Lecture • Lab: Configure a Smart Transmitter for the Process Panel assigned	Chapters 38
10	Advanced Control Strategies • Lecture • Lab: Workbook Exercises • Set up Loop for Process Panel • Test 2	Chapter 38
11	Final Elements • Lecture • Lab: Run Process panel on Manual and Auto.	Chapter 39
12	Actuators and Positioners • Lecture • Lab: Tune Controller on Process Panel assigned • Test 3	Chapter 41
13	Safety Systems • Lecture • Lab: Change assignment to another Process Panel	Chapter 43
14	Electrical Safety Standards • Lecture • Lab: Run new panel assignment on auto	Chapter 44
15	Safety Instrumented Systems • Lecture • Lab: Workbook Exercises	Chapter 45

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Course Syllabus

Week	Topic	Reference
	<ul style="list-style-type: none">• Test 4	
16	Applications <ul style="list-style-type: none">• Lecture• Lab: Workbook Exercises	Chapter 46