

**ITT Technical Institute**

**AM410**

**Process Control Circuits**

**Onsite Course**

**SYLLABUS**

**Credit hours: 4**

**Contact/Instructional hours: 50** (30 Theory Hours, 20 Lab Hours)

**Prerequisite(s) and/or Corequisite(s):**

Prerequisites: ET245 Electronic Devices II or equivalent

**Course Description:**

This course introduces the circuits used in the automatic process control of industrial systems. Areas of instruction include signal conditioning and feedback circuits using analog and digital techniques.

**Outside Work:**

For purposes of defining an academic credit hour for Title IV funding purposes, ITT Technical Institute considers a quarter credit hour to be the equivalent of: (a) at least 10 clock hours of classroom activities and at least 20 clock hours of outside preparation; (b) at least 20 clock hours of laboratory activities; or (c) at least 30 clock hours of externship, practicum or clinical activities. ITT Technical Institute utilizes a "time-based option" for establishing out-of-class activities which would equate to two hours of out-of-class activities for every one hour of classroom time. The procedure for determining credit hours for Title IV funding purposes is to divide the total number of classroom, laboratory, externship, practicum and clinical hours by the conversion ratios specified above. A clock hour is 50 minutes.

A credit hour is an artificial measurement of the amount of learning that can occur in a program course based on a specified amount of time spent on class activities and student preparation during the program course. In conformity with commonly accepted practice in higher education, ITT Technical Institute has institutionally established and determined that credit hours awarded for coursework in this program course (including out-of-class assignments and learning activities described in the "Course Outline" section of this syllabus) are in accordance with the time-based option for awarding academic credit described in the immediately preceding paragraph.



# STUDENT SYLLABUS

Instructor: \_\_\_\_\_

Office hours: \_\_\_\_\_

Class hours: \_\_\_\_\_

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## Major Instructional Areas

### Unit 1

#### Chapter 1: Introduction to Process Control

- Control Systems
- Process Control Block Diagram
- Control System Evaluation
- Analog and Digital Processing
- Units, Standards, and Definitions
- Sensor Time Response
- Significance and Statistics

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### Unit 2

#### Chapter 2: Analog Signal Conditioning

- Principles of Analog Signal Conditioning
- Passive Circuits
- Operational Amplifiers
- Op Amp Circuits in Instrumentation
- Design Guidelines

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### Unit 3

#### Chapter 3: Digital Signal Conditioning

- Review of Digital Fundamentals
- Converters
- Data-Acquisition Systems
- Characteristics of Digital Data

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## **Unit 4**

### **Chapter 4: Thermal Sensors**

- Definition of Temperature
- Metal Resistance versus Temperature Devices
- Thermistors
- Thermocouples
- Other Thermal Sensors
- Design Considerations

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## **Unit 5**

### **Chapter 5: Mechanical Sensors**

- Displacement, Location, or Position Sensors
- Strain Sensors
- Motion Sensors
- Pressure Sensors
- Flow Sensors

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## **Unit 6**

### **Chapter 6: Optical Sensors**

- Fundamentals of EM Radiation
- Photodetectors
- Pyrometry
- Optical Sensors
- Applications

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## **Unit 7**

### **Chapter 7: Final Control**

- Final Control Operation
- Signal Conversion
- Power Electronics
- Actuators

Control Elements

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## **Unit 8**

### **Chapter 9: Controller Principles**

- Process Characteristics
- Control System Parameters
- Discontinuous Controller Modes
- Continuous Controller Modes
- Composite Controller Modes

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## **Unit 9**

### **Chapter 10: Analog Controllers**

- General Features
- Electronic Controllers
- Pneumatic Controllers
- Design Considerations

### **Chapter 11: Computer-Based Control**

- Digital Applications
- Computer-Based Controller
- Control System Networks
- Computer Controller Examples

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## **Unit 10**

### **Chapter 12: Control-Loop Characteristics**

- Control System Configurations
- Multivariable Control Systems
- Control System Quality
- Stability
- Process Loop Tuning

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## Unit 11

### Review and Final Examination

- Review session
- Final examination

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## Course Objectives

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

1. Describe the purpose of each main unit in a process control loop.
2. Interpret a P & ID diagram of a given process control configuration.
3. Describe devices and methods for measuring specified process variables, e.g., pressure, temperature, proximity, liquid level, fluid flow rate, strain, etc.
4. Describe the purpose and operational features of specified final control elements.
5. Define and describe the response of each of the three conventional tuning parameters (proportional, integral and derivative) to characteristics of the error signal input.
6. Demonstrate the determination of PID controller gains using either the "open loop transient response" method or the Ziegler-Nichols method, as specified by the instructor.
7. Configure and program a PID controller to provide feedback control of either a real or a simulated analog process. Bring the process into stable control, with minimum overshoot and setting time, for one or more load changes induced by the instructor.

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## Teaching Strategies

This curriculum is designed to promote a variety of teaching strategies that support the outcomes described in the course objectives and that foster higher cognitive skills. Delivery makes use of various media and delivery tools in the classrooms.

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## Student Textbook and Materials

Text: Johnson, Curtis D. *Process Control Instrumentation Technology*, Custom 8<sup>th</sup> Edition, Pearson Custom Publishing, 2008, ISBN 0-555-00962-9

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## Course Outline

Unit	Topic (Lecture Period)	Chapters	Lab and Other Coverage
1	Introduction to Process Control	1	Lab, Homework Exercises
2	Analog Signal Conditioning	2	Lab, Homework Exercises
3	Digital Signal Conditioning	3	Lab, Homework Exercises
4	Progress Test 1. Thermal Sensors	4	Lab, Homework Exercises
5	Mechanical Sensors.	5	Lab, Homework Exercises
6	Optical Sensors	6	Lab, Homework Exercises
7	Progress Test 2 Final Control	7	Lab, Homework Exercises
8	Controller Principles	9	Lab, Homework Exercises
9	Analog Controllers Computer-Based Control	10 11	Lab, Homework Exercises
10	Control-Loop Characteristics	12	Lab, Homework Exercises
11	Review and Final Examination		The final examination will be based on the content covered in Chapters 1-12.

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## Evaluation Criteria and Grade Weights

Homework	20 %
Progress Test 1	15%
Progress Test 2	15%
Lab Exercises	25%
Final Exam	25%

Final grades will be calculated from the percentages earned in class as follows:

A      90 - 100%      4.0

B+	85 - 89%	3.5
B	80 - 84%	3.0
C+	75 - 79%	2.5
C	70 - 74%	2.0
D+	65 - 69%	1.5
D	60 - 64%	1.0
F	<60%	0.0