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Energy (ENER) 1620 Fundamentals of Instrumentation (3 Units) CSU

Advisory: Eligibility for Math 1060 and English 1500 strongly recommended

Total Hours: 40 hours lecture; 32 hours lab (72 hours total)

Catalog Description: This course is designed to provide students with a basic understanding of instrumentation, processes, and controls that provide energy and oil and gas industries vital information needed to monitor and improve areas of production, safety, and efficiency. Fieldtrips may be required. Course is not open to students who have credit of 'C' or better in ENER 1010.

Type of Class: Degree Credit

Text: McNair, Will L. *Basic Instrumentation*. 4th ed. U of Texas at Austin, 2002.

Center for the Advancement of Process Technology. *Instrumentation*. Pearson, 2009.

Additional Required Materials: Industry resources and materials

Objectives:

By the end of the course, a successful student will be able to:

1. demonstrate a basic understanding of instrumentation and their role in the energy, oil and gas industries,
2. identify instruments used to measure and control pressure, temperature, level and flow
3. define key terms such as gravity, viscosity, density and pH,
4. explain the operation, programming, and calibration of closed loop process controllers and control systems to measure, control of flows, pressures, temperatures, and levels,
5. define closed-loop tuning and apply the concept,
6. describe the operation of Piping and Instrument Design control and apply the concept, and
7. demonstrate the ability to verify accuracy of transmitters, and calibrate using hand held calibrator.

Course Scope and Content (Lecture):

Unit I Measurements

A. Need for Measurement and Control

- B. Methods of Measurement
- C. Instrumentation Symbols and Diagrams
- D. Types of Control
- E. Methods or Modes of Control Types of Measurements

Unit II Final Control Elements

- A. Valves
- B. Sizing and Piping Arrangements
- C. Actuators
- D. Controlled-Volume Pumps
- E. Variable-Volume Pumps
- F. Other Final Control Elements

Unit III Electronic Automatic Controls

- A. Analog Circuits and Equipment
- B. Modes of Control and Control Loops
- C. Programmable Logic Controllers (PLC) Control Systems
- D. Specialized Flow Computers
- E. Distributed Control Systems
- F. Human-Machine-Interface (HMI)

Unit IV Pressure Measurement and Control

- A. Units of Pressure Measurement
- B. Mechanical Pressure Elements
- C. Electronic Pressure Measure
- D. Vacuum Measurements
- E. Pressure Controls

Unit V Temperature Measurement and Control

- A. Defining Temperature Measurement
- B. Mechanical Temperature Sensors
- C. Electronic Temperature Measurement
- D. Electronic Temperature Transmitters
- E. Temperature Control
- F. Special Applications in Thermal Energy

Unit VI Liquid-Level Measurement and Control

- A. Defining Level Measurement
- B. Mechanical Level Sensors
- C. Electrical Level Measuring Devices
- D. Level Control
- E. Flow Measurement
- F. Mechanical flow sensors and meters
- G. Electronic flow sensors and meters

Unit VII Gravity, Viscosity, Humidity and pH



- A. Explore how gravity, viscosity, humidity influence liquids and their measurement
- B. Examine how fluid pH influences the behaviors of liquids and piping

Unit VIII Programmable Logic Controllers (PLC)

- A. PLC Operating Concepts
- B. PLCS Brands
- C. PLC Application and Loop Tuning

Unit IX Piping and Instrument Design (P&ID)

- A. Instrumentation and Designations
- B. Mechanical Equipment with Names and Valves
- C. Valves
- D. Process Piping, Sizes, Identification
- E. Vents, Drains, Special Fitting, Sampling Lines, Reducers, Increases, Swaggers
- F. Permanent Start Up and Flush Lines
- G. Interconnection Reference
- H. Seismic Category
- I. Quality Level
- J. Annunciation Inputs
- K. Computer Control System Input
- L. Vendor and Contractor Interfaces
- M. Identification of Components and Subsystems
- N. Intended Physical Sequence of the Equipment

Course Scope and Content (Laboratory):

Unit I Measurements

- A. Introduction to Lab Safety
- B. Comparison of systems of units
- C. Measuring length
- D. Measuring time
- E. Measuring temperature
- F. Measuring mass, weight and force
- G. Measuring work and energy
- H. Measuring dimensions of various quantities

Unit II Process Control

- A. Examine loop controllers
- B. Examine final control elements
- C. Explore methods of automatic controls

Unit III Level Measurement

- A. Examine liquid level controls
- B. Use mechanical sensors to measure levels
- C. Use electrical sensors to measure levels



- Unit IV Basic Flow Measurement and Control
- A. Use mechanical flow sensors and meters
 - B. Use electronic flow sensors and meters

- Unit V Basic Temperature Control
- A. Use temperature sensors to monitor temperature
 - B. Use temperature transmitters to send temperature data

- Unit VI Gravity, Viscosity, Humidity and pH
- A. Measure Specific Gravity and Density
 - B. Measure Viscosity
 - C. Measure Humidity and Dew Point
 - D. Measure pH

Learning Activities Required Outside of Class:

The students in this class will spend a minimum of 5 hours per week outside of the regular class time doing the following:

1. Reading the required text and other background materials for class
2. Answering questions
3. Studying class materials and notes
4. Researching
5. Problem solving activities and exercises

Methods of Instruction:

1. Lecture
2. Hands-on demonstrations of instruments including field trips as needed
3. Group Activities
4. Guest Presentations
5. Laboratory Assignments

Methods of Evaluation:

1. Written assignments/reports
2. Exams and quizzes:
 - a. Multiple choice, true/false
 - b. Diagram matching
 - c. Read and generate charts used in oil industry
3. Participation
4. Individual and group exercises & projects
5. Practical Observation

Laboratory Category: Extensive Laboratory

Pre delivery criteria: All of the following criteria are met by this lab.

1. Curriculum development for each lab.
2. Published schedule of individual laboratory activities.



3. Published laboratory activity objectives.
4. Published methods of evaluation.
5. Supervision of equipment maintenance, laboratory setup, and acquisition of lab materials and supplies.

During laboratory activity of the laboratory: All of the following criteria are met by this lab.

1. Instructor is physically present in lab when students are performing lab activities.
2. Instructor is responsible for active facilitation of laboratory learning.
3. Instructor is responsible for active delivery of curriculum.
4. Instructor is required for safety and mentoring of lab activities.
5. Instructor is responsible for presentation of significant evaluation.

Post laboratory activity of the laboratory: All of the following criteria are met by this lab.

1. Instructor is responsible for personal evaluation of significant student outcomes (lab exercises, exams, practicals, notebooks, portfolios, etc.) that become a component of the student grade that cover the majority of lab exercises performed during the course.
2. Instructor is responsible for supervision of laboratory clean-up of equipment and materials.

Supplemental Data:

TOP Code:	093400: Electronics and Electric Techn
SAM Priority Code:	C: Clearly Occupational
Distance Education:	Not Applicable
Funding Agency:	Y: Not Applicable(funds not used)
Program Status:	1: Program Applicable
Noncredit Category:	Y: Not Applicable, Credit Course
Special Class Status:	N: Course is not a special class
Basic Skills Status:	N: Course is not a basic skills course
Prior to College Level:	Y: Not applicable



Cooperative Work Experience:	N: Is not part of a cooperative work experience education program
Eligible for Credit by Exam:	E: Credit By Exam
Eligible for Pass/No Pass:	NO
Taft College General Education:	NONE