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Energy (ENER) 1515 Fundamentals of Instrumentation for Energy Industries (3 Units) CSU
[formerly Energy 1010]

Advisory: Eligibility for Math 1060 and English 1500 strongly recommended

Total Hours: 48 hours lecture

Catalog Description: This course is designed to provide students with a basic understanding of instrumentation and processes that provide energy and oil and gas industries vital information needed to monitor and improve production, and improve 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. Austin: U of Texas, 2002. Print.

Center for the Advancement of Process Technology. *Instrumentation*. Upper Saddle River: Prentice Hall, 2010. Print.

Additional Instructional 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 processes of measurement, control of flow, pressure and temperature and level, and
5. demonstrate the ability to verify accuracy of transmitters, and calibrate using hand held calibrator.

Course Scope and Content:

- Unit I Measurements
- A. Need for Measurement and Control
 - B. Methods of Measurement
 - C. Types of Control
 - D. Methods or Modes of Control

- E. Types of Measurements
 - a. comparison of systems of units
 - b. measuring length
 - c. measuring time
 - d. measuring temperature
 - e. measuring mass, weight and force
 - f. measuring work and energy
 - g. measuring dimensions of various quantities
- 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
- 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

- a. mechanical flow sensors and meters
- b. electronic flow sensors and meters

Unit VII Gravity, Viscosity, Humidity and pH

- A. Measuring Specific Gravity and Density
- B. Measuring Viscosity
- C. Measuring Humidity and Dew Point
- D. Measuring pH

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

Learning Activities Required Outside of Class:

The students in this class will spend a minimum of 6 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

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