Lecture Contact Hours: 48-54; Homework Hours: 96-108; Total Student Learning Hours: 144-162

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

CENTER FOR WATER STUDIES 106 – ELECTRICAL & INSTRUMENTATION PROCESSES

3 hours lecture, 3 units

Catalog Description
An introductory course in basic electronic, electrical, and control system principles. Electrical safety precautions, component identification, schematic interpretation, motors, transformers, relays and test equipment will be studied. Automated process control devices and an overview of current technologies will be discussed.

Prerequisite
None

Course Content
1) Electrical
    a. Electrical safety precautions
        1. Cause of electrical shock
        2. Lethal potentials (current and voltage)
        3. Prevention of electrical shock
        4. Action taken in the event of electrical shock
    b. Electron theory and electrical principles
        1. Magnetism
        2. Induction
        3. Voltage, current, resistance, (Ohm's Law)
        4. Power measurements
        5. D.C. circuits
        6. A.C. circuits
        7. Electrical terms
    c. Electrical and electronic components
        1. Resistor (fixed and variable)
        2. Capacitor (fixed and variable)
        3. Fuse
        4. Inductor (coil)
        5. Switches
        6. Relay
        7. Transistor
        8. Diode
        9. Silicon controlled rectifies (scr)
        10. Transformer
        11. Terminal board and buss bar
        12. Solid state devices
        13. Circuit breakers
    d. Schematic interpretation
        1. Simple circuit
        2. Complex circuit
        3. Line diagram
        4. Control circuit

e. Transformers
    1. Construction
    2. Losses
    3. Step up step down
    4. Power
    5. Three-phase
    6. Wye and Delta
f. Relays
    1. Construction
    2. Operation and use
    3. Voltage
    4. Single pole double throw (SPDT)
    5. Double pole double throw (DPDT)
g. Motors
    1. Motor theory
    2. DC motors
    3. Single phase
    4. Three phase
    5. Reduce voltage starting
    6. Horsepower
    7. Interpret name plate data
    8. Calculate and control energy costs
h. Test equipment
    1. Multimeter
    2. Clamp-on-ammeter
    3. Megger

2) Instrumentation
a. Terminology
    1. Definitions
    2. Instrument symbols
    3. Process characteristics
    4. Instrument characteristics
    5. Instrument identification
b. Control systems
    1. Process/control
    2. Controls
    3. Types of control
    4. PID (proportional-integral-derivative) Loops
c. Sensing and sampling devices
    1. Flow
    2. Pressure
    3. Temperature
    4. Level
    5. Water quality instrumentation
    6. Gas and leak detection
d. Readout
    1. Indicators
    2. Recorders
    3. Digital
e. Remote control systems
    1. Various functions performed
    2. Devices used
    3. Metering circuits
    4. Power supplies

5. Land line
6. Radio systems

f. Current technologies
   1. SCADA (Supervisory Control and Data Acquisition) central computer systems
   2. Local area communication network
   3. Wide area communication network
   4. PLC's and other programmable devices
   5. Operator HMI panels
   6. Applications

g. Specifications and records
   1. Maintenance
   2. Training
   3. Contracts and service

h. Field trips
   1. Helix R.M. Levy WTP

Course Objectives

Students will be able to:

1) Understand electrical safety precautions
2) Describe electron theory and electrical principles
3) Distinguish between electrical and electronic components
4) Comprehend schematic interpretation
5) Understand the uses of transformers and relays in motor control systems
6) Describe instrumentation and control terminology
7) Identify commonly used sensing and sampling devices
8) Understand the uses of digital indicators and recorders as utilized in remote control systems
9) Describe the functions of a SCADA (Supervisory Control and Data Acquisition) central computer system
10) Distinguish between Local and Wide area communication networks
11) Describe how PLC's and other programmable devices are used in automated control systems
12) Discuss the uses of operator HMI panels in a control system

Method of Evaluation

A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in subject matter determined by multiple measurements for evaluation, one of which must be essay exams, skills demonstration or, where appropriate, the symbol system.

1) Projects
2) Writing assignments
3) Exams & quizzes
4) Demonstrations utilizing the Field Operations Skills Yard

Special Materials Required of Student

None

Minimum Instructional Facilities

Smart classroom

Method of Instruction

1) Lecture and discussion
2) Audiovisual
3) Field trips
4) Demonstrations utilizing the Field Operations Skills Yard

Out-of-Class Assignments
1) Reading assignments
2) Writing assignments
3) Projects and reports

Texts and References
1) Required (representative example): Herman, Stephen. *Standard Textbook of Electricity*. Delmar Cengage Learning, 2011.
2) Supplemental: None

Exit Skills
Students having successfully completed this course exit with the following skills, competencies and/or knowledge:
1) Knowledge of instrumentation and control system terminology
2) Ability to read schematic representations commonly used in Programmable Logic Controllers and other programmable devices
3) Identify sensing and sampling devices commonly used in automated control systems
4) Describe how Programmable Logic Controllers and other programmable devices are utilized in automated control systems
5) Discuss the various functions of a Supervisory Control and Data Acquisition (SCADA) central computer system

Student Learning Outcomes
Upon successful completion of this course, students will be able to:
1) Label common electrical/electronic components both physically and through schematic interpretation.
2) Describe basic electronic theory and electrical principles and explain how motors, transformers, relays and test equipment are used in the electrical, electronic, and instrumentation field.
3) Identify instruments and control systems both physically and through schematic interpretation.
4) List and describe the operation of electrical motors, control systems, and PID loops.
5) List and describe in detail the three main components of a SCADA system and how each system operates.