Texas Education Agency

Introduction to Instrumentation and Electrical

PEIMS Code: N1303900
Abbreviation: INSTELEC
Grade Level(s): 10–12
Award of Credit: 1.0

Approved Innovative Course

- Districts must have local board approval to implement innovative courses.
- In accordance with Texas Administrative Code (TAC) §74.27, school districts must provide instruction in all essential knowledge and skills identified in this innovative course.
- Innovative courses may only satisfy elective credit toward graduation requirements.
- Please refer to TAC §74.13 for guidance on endorsements.

Course Description:

Introduction to Instrumentation and Electrical will introduce students to instrumentation professions, including the different career opportunities available and required certification/postsecondary education requirements for each. Introduction to Instrumentation is the first of two courses that provide a pathway for the student to learn core competencies, as identified by industries using process instrumentation and postsecondary institutions such as simple control loops, an introduction to pressure, temperature, level, flow transmitters and the various transducers used in the detection of changes in process variables.

Essential Knowledge and Skills:

(a) General requirements. This course is recommended for students in grades 10-12. Recommended prerequisite: Integrated Chemistry and Physics (IPC) or Chemistry. Students shall be awarded one credit for successful completion of this course.

(b) Introduction.

(1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.

(2) The Energy Career Cluster focuses on planning, managing, and performing the processing of materials into intermediate or final energy products and related professional and technical support activities such as production planning and control, maintenance, and manufacturing/process engineering.

(3) Introduction to Instrumentation will introduce students to instrumentation professions, including the different career opportunities available and required certification/postsecondary education requirements for each. Introduction to Instrumentation is the first of two courses that provide a pathway for the student to learn core competencies, as identified by industries using process instrumentation and postsecondary institutions such as simple control loops, an introduction to

pressure, temperature, level, flow transmitters and the various transducers used in the detection of changes in process

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations;

(B) demonstrate the standards required in the workplace such as interviewing skills, flexibility, willingness to learn new skills and acquire knowledge, self-discipline, self-worth, positive attitude, and integrity in a work situation;

(C) collaborate with others to solve problems;

(D) identify employers' work expectations; and

(E) research, evaluate and apply various time-management techniques to develop work schedules.

(2) The student understands common definitions, terminology, and the basic foundations related to instrumentation. The student is expected to:

(A) describe the types of industry using instrumentation, and identify fields related to instrumentation in process technology;

(B) describe the career opportunities in instrumentation in process technology, pathways to career development, and certification requirements of industries using process technology, including job responsibilities, typical work schedules, and career opportunities;

(C) demonstrate the use of content, such as technical concepts and vocabulary, when analyzing information and following directions;

(D) identify currently emerging issues in instrumentation in process technology; and

(E) identify principles of instruments and instrument technology used in industrial process technology.

(3) The student can identify and discuss process instruments and devices. The student is expected to:

(A) discuss process instruments and equipment used in industry, including symbology; and

(B) demonstrate the ability to read Process Flow Diagrams (PFD), read & draw Piping & Instrumentation Diagrams (P&ID’s) and Loop Drawings, which are the specifications of the instrumentation used.

(4) The student can identify and discuss the types of control loops applied to the control and detection of pressure, temperature, level, flow, pH, and other applicable processes. The student is expected to:

(A) demonstrate the ability to read and interpret the types of industrial drawings, diagrams, charts, and data sheets related to industrial electrical equipment;

(B) interpret industry standard circuit schematics, including simple circuits, series circuits, parallel circuits, Ohm's Law, Watt's Law, and the Power Law;

(C) identify areas where quality, reliability, and safety can be integrated into a product; and

(D) describe applications of electricity in industrial process technology, including alternating current (AC), direct current (DC) 3 phase motor, and variable frequency drives, and where and why they are used in industry.

(5) The student develops knowledge of measurements and calibration of instrumentation. The student is expected to discuss and demonstrate how precision measuring instruments are used in industrial process technology, including a digital multi-meter (DMM).

(6) The student develops familiarization of the communicator. The student is expected to:

(A) evaluate common communicators, such as an EMERSON 475, and select a communicator appropriate to a specified task; and

(B) calibrate microprocessor-based self-monitoring analysis and reporting technology (SMART) instruments and pneumatics such as a 13A Differential Pressure Transmitter (D/P) Transmitter as well as other electronic transmitters.

(7) The student applies concepts of critical thinking and problem solving. The student is expected to:

(A) analyze elements of a problem to develop innovative solutions;

(B) critically analyze information to determine value to the problem-solving task;

(C) analyze a variety of problem-solving strategies and critical-thinking skills; and

(D) conduct technical research to gather information necessary for decision making.

(8) The student applies comprehensive knowledge in a simulation environment. The student is expected to:

(A) represent or simulate a portion of a process system by generating an appropriate drawing, diagram, or data sheet;

(B) demonstrate how to achieve a specific goal with the use of a simple mock-up of a "Control Loop";

(C) execute a simple mockup of a control loop to achieve a specified goal;

(D) use instruments to put together a simple loop;

(E) demonstrate appropriate safety equipment selection for use in a variety of assigned tasks;

(F) use a Sniffer for confined space entry to be sure of adequate oxygen;

(G) identify and apply mathematical operations to complete calculations and specified computations, including temperature unit conversions, for a simulated process system;

(H) explain how visual depictions, data readouts, and trends in a computer-based process simulator relate to actual valves, piping, equipment, electrical gear, and instrumentation in a process system;

(I) develop critical-thinking skills through simulations to identify and solve problems associated with instrumentation in process technology; and

(J) describe how to troubleshoot specific instruments and processes.

(9) The student presents conclusions, research findings, and designs using a variety of media throughout the course. The student is expected to:

(A) discuss and critique the validity of conclusions supported by the data through various methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports; and

(B) record, express, and manipulate relationships among data, including the use graphs, charts, and equations.

Recommended Resources and Materials:

Weedon, Thomas A., Philip Kirk, and Franklyn W. Kirk. *Instrumentation and Process Control*. Orland Park, IL: American Technical Publishers, 2019.

- Industry-level equipment such as Fluke 787 RMS DMM, EMERSON 475 Communicator, Meriam Communicator.
- PIE or ALTEK 4-20 mA driver.
- Fluke 724 Temperature Calibrator.
- Rosemount Instrumentation (SMART).
- Pneumatics, Electronic.
- Ball Valve, Globe, Butterfly, Gate Valve rising stem.
- Swing Check.
- Flowserve BETA &/or LOGIX. 667 EZ Fisher Actuator Pneumatic and digital valve controller 6200 with I/P.

Recommended Course Activities:

- Study-guides by topic
- Project based activities using industry-level equipment such as pipes and valves
- Simulated control loops
- Creating lab reports

Suggested methods for evaluating student outcomes:

- Written papers

- Written tests
- Oral reports
- Lab reports such as calibration reports, as found, as left, five-point checks. Report written on the work order so there is a history of what was performed to that specific instrument.

Teacher qualifications:

An assignment for Introduction to Instrumentation and Electrical is allowed with one of the following certificates.

- Secondary Industrial Arts (Grades 6-12).
- Secondary Industrial Technology (Grades 6-12).
- Technology Education: Grades 6-12.
- Trade and Industrial Education: Grades 6-12. This assignment requires appropriate work approval.
- Trade and Industrial Education: Grades 8-12. This assignment requires appropriate work approval.
- Vocational Trades and Industry. This assignment requires appropriate work approval.
- Mathematics/Physical Science/Engineering: Grades 8-12.

Additional information: