INSTRUMENTATION – TECHNICIAN (INSTN 2021)

Preamble

The Canadian Technology Standards (CTS) are a collection of learning outcomes for Canada's engineering technology and applied science profession at the technician and technologist level.

Stakeholders

The CTS may be utilized by accreditation bodies, provincial professional associations, educational institutions, government agencies, industry and others for the purposes accreditation, certification and other applications.

Educational Programs

The Instrumentation CTS is relevant to programs including, but not limited to, process control, control systems, environmental controls, automation, avionic instrumentation, and biomedical instrumentation at the at the technician level.

Learning Outcomes

This CTS list Discipline Learning Outcomes (DLO) which describe the significant and essential learning that students have achieved and can reliably demonstrate at the time of graduation. Each DLO has a number of Learning Outcome Indicators (LOI), which are examples illustrating, defining and clarifying the level of performance expected. The list of LOI is not comprehensive and there may be other indicators which can be used to assess achievement of learning outcomes.

DLO and their LOI employ only cognitive domain verbs selected from a table of cognitive verbs modeled after a Bloom's cognitive domain table of verbs adapted specifically for engineering technology and applied science disciplines.

Graduate Capability

Students graduating from an accredited program have demonstrated achievement of all general learning outcomes, including a prescribed level of math, and discipline learning outcomes selected by the program.

Having completed a program that is based on applied mathematics and scientific and engineering theory, principles and practices and having acquired the knowledge, skills and attitudes to function in the work place, graduates are;

- able to evaluate assignments, establish objectives, set parameters and determine appropriate procedures and actions.
- able to exercise due diligence in the workplace and adhere to related practices, applicable laws and health and safety practices.
- able to work in accordance with labor-management principles and practices.
- able to work independently or interdependently as part of a discipline or multi-disciplinary team.
- prepared to assume responsibility for their work.

Graduate Career Opportunities

Graduates of Instrumentation Technology - Technician programs have career opportunities in such areas as: business, industry, construction, government, and public organizations. They may find employment in careers such as: maintenance of equipment, processes, infrastructure, or systems; preparation of specifications, drawings, or instructions; quality operations; operations and maintenance; field and customer service; estimating; technical sales; supervision of projects; training activities; and many other areas.

Discipline Learning Outcomes (DLOs)

INSTN01 Industrial Processes

- Collaborate to analyze the performance of industrial processes.

Learning Outcome Indicators include:

1.1 Discuss instrumentation and control loop diagrams.
1.2 Predict the automatic open loop response of standard PID controllers.
1.3 Calculate and identify the effect that frequency of input signal has on gain and phase shift for a given transfer functioned.
1.4 Collaborate in specifying control modes and determining tuning parameters to achieve good control in common control loops.
1.5 Determine the effects of and methods to overcome process problems such as nonlinearity, non-symmetry, and dead time on operation of control loops.
1.6 Determine the effects of and methods to overcome process disturbances on operation of control loops.
1.7 Troubleshoot various control configurations used in a typical control system.
1.8 Collaborate in the analysis of the operation of advanced control systems used on common process equipment.
1.9 Explain electrical control symbols commonly used in instrumentation.
1.10 Program and configure an industrial controller for industrial control application.

INSTN02 Calibrate and Troubleshoot

- Calibrate and troubleshoot various process instruments commonly used in industry.

Learning Outcome Indicators include:

2.1 Calibrate and service the operation of electromechanical, pneumatic, and hydraulic instruments used to indicate or record pressures, levels, temperatures, flows, weights, densities and other variables, and explain their operation.
2.2 Service various types of control valves, actuators, and positioners.
2.3 Develop different instrumentation and control loop diagrams.
2.4 Specify measurement systems.
2.5 Determine appropriate types and sizes of final control elements.
2.6 Configure, program and install all types of smart (digital) sensors.
2.7 Calibrate digital sensors using manufacturing software.

INSTN03 Analytical Instruments and Sampling Systems

- Review implementation and applications of various analytical instruments and analyzer sampling systems.

Learning Outcome Indicators include:

3.1 Identify parts of analyzer and analyzer sampling systems, and explain the importance of system accuracy.
3.2 Discuss different methods used to calibrate analyzers.
3.3 Explain the operating principles and applications for various types and configurations of chromatographs.
3.4 Explain the operating principles and applications of pH and other specific ion and oxidation/reduction potential analyzers.
3.5 Explain the operating principles and applications of moisture analyzers.
3.6 Explain the operating principles and applications of ultraviolet, infrared, fluorescent, and chemiluminescent analyzers.
3.7 Explain the operating principles and applications of safety and environmental analyzers.
3.8 Explain the application of analyzers in combustion control.
3.9 Explain the operating principles and applications of physical properties analyzers.
3.10 Apply standardization and calibration methods for analyzers used in industrial environment according to applicable standards.

INSTN04 Industrial Network and Wireless Communications Systems

- Troubleshoot industrial network and wireless communications systems.

Learning Outcome Indicators include:

4.1 Describe communication-signalling methods and diagram how data is packaged for data transmission.
4.2 Describe common network topologies, devices, and access methods used in industrial communication protocols.
4.3 Use software tools to diagnose network communications.
4.4 Configure smart field devices and controllers for communications in the implementation of a control strategy.
4.5 Implement and troubleshoot common fieldbus networks.
4.6 Describe common fieldbus protocols.
4.7 Describe applications and characteristics of Data Acquisition Systems.

INSTN05 Supervisory Control Systems

- Collaborate in the application of programmable logic controllers (PLCs), distributed control systems (DCSs), and supervisory control systems for control of manufacturing and processing systems.

Learning Outcome Indicators include:

5.1 Collaborate to analyze the operation and function of various PLC devices in a process environment.
5.2 Apply various logic software (Visual Basic, C++) in order to optimize the application of PLCs.
5.3 Apply advanced instruction sets of typical PLCs.
5.4 Test program and troubleshoot specific programmable logic controllers for typical control applications.
5.5 Configure PLCs to perform various tasks.
5.6 Explain the basic concepts and fundamentals of DCSs.
5.7 Explain the operation and function of various components of DCSs.
5.8 Configure typical DCSs.

INSTN06 Safety Systems

- Collaborate in the design of control and safety systems for industrial processes using basic engineering principles and knowledge of industrial control systems.

Learning Outcome Indicators include:

6.1 Collaborate in the development of engineering projects utilizing engineering and project management software tools.
6.2 Collaborate in selecting electronic equipment, components, and systems by consulting manufacturers' specifications.
6.3 Prepare engineering drawings and supporting documentation.
6.4 Explain principles of project management.
6.5 Apply principles of team building in engineering projects.
6.6 Apply established codes of professional ethics.
6.7 Apply environmental regulations and practices.

INSTN07 Microcontroller-based Systems

- Collaborate in specifying, troubleshooting, and building microprocessor or microcontroller-based systems for engineering applications.

Learning Outcome Indicators include:

7.1 Create a clear functional specification document for microprocessor- or microcontroller- based systems.
7.2 Collaborate in the selection and specifying of computer-related hardware and software to meet design specifications.
7.3 Collaborate in the design of microprocessor or microcontroller-based systems using knowledge of computer- related hardware and software.

7.4 Collaborate in evaluating, testing and constructing microprocessor or microcontroller-based systems.
7.5 Apply microprocessor and microcontroller processing techniques that are sensitive to static loads.
7.6 Collaborate in solving microprocessor or microcontroller-based system design and functionality issues.

INSTN08 Industrial Automation

- Collaborate to analyze applications of robotic systems in industrial automation or advanced manufacturing systems.

Learning Outcome Indicators include:

8.1 Explain manufacturing concepts, such as JIT, CIM, CAD/CAM applications.
8.2 Classify types of robots used in industrial automation or advanced manufacturing systems.
8.3 Explain the design of flexible manufacturing systems.
8.4 Troubleshoot the kinematic control and performance of robotic systems.
8.5 Collaborate in analyzing the utilization, processing, and interpretation of sensory information in robotic systems.
8.6 Collaborate in selecting, specifying, and troubleshooting a range of tactile, touch, and vision sensors for application in robotic systems.
8.7 Collaborate in selecting and specifying robotic end effectors for an application.
8.8 Collaborate in the analysis of and reporting on performance of typical robotic systems, assessing design, operational capability, and safety considerations.

INSTN09 Electrical Systems

- Test and troubleshoot electrical systems in modern industrial environment.

Learning Outcome Indicators include:

9.1 Test and troubleshoot types of single and three-phase electric motors, electric motor control configurations, and types of electrical control devices commonly used in a modern industrial environment.
9.2 Explain and troubleshoot the performance of electric motors or motor control devices.
9.3 Explain the function and operation of typical variable speed drives and frequency speed circuitry.
9.4 Test and troubleshoot variable speed drives.
9.5 Apply and explain manufacturing software used by control systems of various types of power drives.
9.6 Calibrate and install various speed, amperage, torque, and other sensors used to monitor and control electrical motor drive systems.
9.7 Collaborate in diagnosing, configuring, and programming motor controls used in robotic systems applying appropriate manufacturing software.

INSTN10 Quality Assurance

- Apply Quality Assurance concepts and principles.

Learning Outcome Indicators include:

10.1 Apply sampling procedures to determine in-plant quality levels.
10.2 Apply principles of reliability testing.
10.3 Monitor and evaluate supplier quality performance.
10.4 Implement inspection and quality improvement strategies to reduce production costs.