INSTRUMENTATION – TECHNOLOGIST (INSTY 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 technologist 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.

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 Engineering Technology - Technologist programs have career opportunities in such areas as: business, industry, construction, government, and public organizations. They may find employment in careers such as: design of equipment, processes, infrastructure, or systems; maintenance of instruments, equipment or systems; interpretation or preparation of specifications, technical drawings, or instructions; quality management and inspection; project management; administration; manufacturing operations; field and customer service; estimating; technical sales; supervision of manufacturing; supervision of projects; and training activities.

Discipline Learning Outcomes (DLOs)

INSTY01 Industrial Process Analysis

- Analyse performance of industrial processes applying principles of process control.

Learning Outcome Indicators include:

1.1 Interpret and create instrumentation and control loop diagrams, including P&ID and loop wiring diagrams.
1.2 Analyze and predict automatic open loop response of standard PID controller and cascade mode.
1.3 Interpret and calculate effect that frequency of input signal has on the gain and phase shift for a given transfer function.
1.4 Specify control modes and determine tuning parameters to achieve good control in common control loops.
1.5 Appraise effects of and methods to overcome process problems such as nonlinearity, non-symmetry, and dead time on operation of control loops.
1.6 Appraise effects of and methods to overcome process disturbances on operation of control loops.
1.7 Diagnose various control configurations used in typical control system.
1.8 Analyze operation of advanced control systems used on common process equipment such as heat exchangers, steam boilers, gas compressors, distillation columns, and chemical reactors.
1.9 Interpret electrical control symbols commonly used in instrumentation.
1.10 Configure and program an industrial controller for an industrial control application.

INSTY02 Process Instruments

- Diagnose, specify, and calibrate various process instruments commonly used in industry applying concepts of measurement and sensor selection.

Learning Outcome Indicators include:

2.1 Validate calibration and service operation of electromechanical, pneumatic, and hydraulic instruments used to indicate or record pressures, levels, temperatures, flows, weights, densities and other variables.
2.1.1 Explain the operation of the above.
2.2 Diagnose and service various types of control valves, actuators, and positioners.
2.3 Create and interpret different instrumentation and control loop diagrams, including P&ID and loop wiring diagrams.
2.4 Select and specify measurement systems, complete with any specialized requirements, such as winterization enclosures.
2.5 Appraise appropriate types and sizes of final control elements, flow meters, piping, and relief systems for given process using standard sizing formulas and computer software.
2.6 Interpret, configure, program and install all types of smart (i.e., digital) sensors.

2.7 Interpret and apply manufacturing software to calibrate, standardize, and digital sensors.

INSTY03 Analytical Instruments and Analyzer

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

Learning Outcome Indicators include:

3.1 Analyze parts of analyzer and analyzer sampling systems.
3.1.1 Understand importance of system accuracy.
3.2 Evaluate and discuss some of the different methods used to calibrate analyzers.
3.3 Interpret operating principles and applications for various types and configurations of chromatographs.
3.4 Interpret operating principles and applications of pH, other specific ions, and oxidation/reduction potential analyzers.
3.5 Interpret operating principles and applications of moisture analyzers.
3.6 Interpret operating principle and applications of ultraviolet, infrared, fluorescent, and chemiluminescent analyzers.
3.7 Interpret operating principles and applications of safety and environmental analyzers.
3.8 Interpret application of analyzers in combustion control.
3.9 Interpret operating principles and applications of physical properties analyzers.
3.10 Interpret and apply standardization and calibration methods of analyzers used in industrial environment according to applicable standards.

INSTY04 Communications Systems

- Diagnose, analyze, configure, and implement network and wireless communications systems including field-bus network, and smart field devices and controllers.

Learning Outcome Indicators include:

4.1 Select suitable transmission media for industrial applications applying properties of common hardware and software media.
4.2 Interpret communication-signalling methods and diagram how data is packaged for data transmission.
4.3 Interpret common network topologies, devices, and access methods used in industrial communication protocols.
4.4 Analyze and troubleshoot network communications utilizing software tools.
4.5 Configure smart field devices and controllers for communications in implementation of control strategy.
4.6 Diagnose and implement common field-bus networks.
4.7 Interpret and compare common field-bus protocols.

4.8 Interpret and discuss applications and characteristics of Data Acquisition Systems, Distributed Control Systems, and Supervisory Control and Data Acquisition (SCADA) systems.
4.9 Interpret function of each layer of International Standards Organization - Open Systems Interconnection (OSI) model.

INSTY05 Programmable Logic Controllers

- Organize control of manufacturing and processing systems applying programmable logic controllers (PLC) and supervisory control systems.

Learning Outcome Indicators include:
5.1 Analyze operation and function of various PLC devices in process environment.
5.2 Interpret and apply logic software to optimize application of PLCs.
5.3 Apply advanced instruction sets of typical PLC.
5.4 Diagnose, test, and program specific programmable logic controllers for typical control applications.
5.5 Configure PLCs to perform various tasks.
5.6 Analyze basic concepts and fundamentals of Distributed Control Systems (DCSs).
5.7 Analyze operation and function of various components of DCSs.

INSTY06 Control and Safety Systems

- Design control and safety systems for industrial processes applying basic engineering principles and knowledge of industrial control systems.

Learning Outcome Indicators include:
6.1 Use project management software tools in development of engineering project.
6.2 Interpret source documents from manufacturers and suppliers to obtain information required to select and purchase appropriate equipment, components, and systems.
6.3 Appraise functional specifications of the equipment, components, and systems.
6.4 Select electronic equipment, components, and systems by consulting manufacturers' specifications, catalogues, and electronic sources (i.e., Internet, CD-ROM).
6.5 Design and develop Safety Instrumented System and hazardous operability analysis for project.
6.6 Create requisite engineering drawings and supporting documentation.
6.7 Interpret principles of project management, complete with related software.
6.8 Design and implement projects applying industry codes and standards, including occupational health and safety.
6.9 Apply principles of team building in engineering project.
6.10 Apply established codes of professional ethics.
6.11 Interpret and apply environmental regulations and practices.

INSTY07 Microprocessor or Microcontroller

- Diagnose, select, specify, design, and assemble microprocessor or microcontroller-based systems for engineering applications.

Learning Outcome Indicators include:

7.1 Create a clear functional specification document given a specific application for microprocessor or microcontroller-based system.
7.2 Select and specify computer-related hardware and software to meet design specifications.
7.3 Design microprocessor or microcontroller-based systems using knowledge of computer related hardware and software.
7.4 Evaluate, test, and construct microprocessor or microcontroller-based systems.
7.5 Interpret and apply processing techniques used by microprocessors and microcontrollers.
7.6 Analyze and resolve microprocessor or microcontroller-based system design and functionality issues.
7.7 Design, code, and debug both high-level and assembly language programs for use in microprocessor or microcontroller applications using appropriate debug and compile environment.

INSTY08 Robotic Systems

- Analyze applications of robotic systems in industrial automation or advanced manufacturing systems, with particular emphasis on kinematics of robotics systems and utilization of sensory information in working environments.

Learning Outcome Indicators include:

8.1 Analyze manufacturing concepts such as JIT, CIM, and CAD/CAM applications.
8.2 Classify types of robots used in industrial automation or advanced manufacturing systems.
8.3 Analyze design of flexible manufacturing system.
8.4 Diagnose and test kinematic control and performance of robotic system.
8.5 Analyze utilization, processing, and interpretation of sensory information in robotic system.
8.6 Diagnose, select, and specify a range of tactile, touch, and vision sensors for applications in robotics system.
8.7 Select and specify robotic end effectors for application.
8.8 Analyze and report on performance of typical robotic system, assessing its design and operational capability, and safety considerations.

INSTY09 Electrical Systems

- Diagnose, test, and analyze electrical systems in modern industrial environment.

Learning Outcome Indicators include:

9.1 Diagnose, test and analyze types of single and three-phase electric motors, electric motor control configurations, and types of electrical control devices commonly used in modern industrial environment.
9.2 Diagnose and analyze performance of electric motor or motor control device.
9.3 Analyze function and operation of typical variable speed drives and frequency speed circuitry.
9.4 Diagnose and test variable speed drives.
9.5 Interpret and apply manufacturing software used by control systems of various types of power drives.
9.6 Appraise, install and calibrate various speed, amperage, torque, and other sensors used to monitor and control electrical motor drive systems.
9.7 Interpret and apply manufacturing software to configure, program and diagnose motor controls used in robotic systems.

INSTY10 Quality Assurance

- Apply fundamental quality assurance concepts and principles.

Learning Outcome Indicators include:

10.1 Create and apply sampling procedures to determine in-plant quality levels.
10.2 Apply principles of reliability testing.
10.3 Evaluate and monitor supplier quality performance.
10.4 Design and implement inspection and quality improvement strategies to reduce production costs.