ELECTROMECHANICAL – TECHNICIAN (EMTN 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 Electromechanical CTS is relevant to programs including, but not limited to, automation, robotics and industrial control systems 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 Electromechanical Engineering 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)

EMTN01 Build Components

- Build mechanical components and assemble electrical components and electronic assemblies.

Learning Outcome Indicators include:

1.1 Operate and maintain hand and power tools according to standard practice.
1.2 Apply soldering and de-soldering techniques.
1.3 Assemble printed circuit boards.
1.4 Prepare wire and cable assemblies.
1.5 Maintain, repair and replace electrical, electronic, and mechanical components.
1.6 Use basic machine shop skills such as turning, milling, metal-bending, drilling, tapping, machining, and cutting according to job specifications.
1.7 Test and troubleshoot electrical panel assemblies.
1.8 Collaborate to analyze components of a breadboard and a PCB.
1.9 Operate equipment according to job requirements and specifications.

EMTN02 Drawing Production

- Produce electrical, electronic, and mechanical drawings and other related documents and graphics to appropriate engineering standards.

Learning Outcome Indicators include:

2.1 Produce or reproduce drawings using computer-aided drafting.
2.2 Produce and modify drawings effectively.
2.3 Prepare electrical, electronic, and mechanical specifications and project-related documents.
2.4 Produce effective sketches, diagrams, charts, tables, and graphs utilizing computer software and other technology.
2.5 Organize and prepare documents in accordance with recognized standards and codes.

EMTN03 Electro-mechanical Circuits

- Test and troubleshoot electro-mechanical circuits, equipment, processes, systems, and sub-systems.

Learning Outcome Indicators include:

3.1 Use standard mechanical, electrical, and electronic testing and measurement equipment such as scopes, digital voltmeter, protocol analyzers, cable testers, calipers, verniers, and voltmeters.
3.2 Use a variety of references including colleagues, manufacturers' manuals, handbooks, and electronic references to complete troubleshooting.

3.3 Troubleshoot in accordance with principles and practices of electromechanical

engineering procedures and practices.
3.4 Use the correct testing equipment and setup for accurate assessment of equipment performance.
3.5 Test, maintain, and repair equipment.
3.6 Implement safety practices in testing and operating conditions.
3.7 Implement established service schedules.
3.8 Troubleshoot electromechanical system problems using appropriate test instrumentation, schematics, and technical reference manuals.
3.9 Discuss appropriate repair process and initiate repair.

EMTN04 Maintain and Repair

- Maintain and repair electrical, electronic, and mechanical components, equipment, and systems.

Learning Outcome Indicators include:

4.1 Configure, install, and commission components, equipment, and systems.
4.2 Operate equipment according to functional specifications and safety procedures.
4.3 Implement regular inspection and service schedules.
4.4 Install, troubleshoot, repair, and modify equipment to keep operations running efficiently.
4.5 Operate, adjust, and repair common types of instrumentation.
4.6 Test, troubleshoot, and repair typical electromechanical systems such as replacing wiring, valves, piping, and electromechanical devices.
4.7 Maintain and repair electrical and electronic systems, including devices, subsystems, wiring, and cabling to circuit board level.

EMTN05 Manufacturing and Handling

- Collaborate in specifying manufacturing materials, processes, and operations.

Learning Outcome Indicators include:

5.1 Troubleshoot, source, and select mechanical power transmission components and systems.
5.2 Collaborate to analyze mechanical components and prototypes used in manufacturing processes and systems.
5.3 Collaborate to analyze properties of materials and assess their suitability for use in a mechanical system.
5.4 Recognize the effects of manufacturing processes on materials and on design and production of components.
5.5 Use systematic approaches to assist in the identification and resolution of technical problems.
5.6 Identify and apply material testing methods.
5.7 Collaborate in sourcing material, tools, equipment, supplies, and services related to production of components.
5.8 Support manufacturing and handling of components applying knowledge of

manufacturing techniques.

EMTN06 Troubleshooting

- Build and troubleshoot logic and digital circuits, passive AC and DC circuits, and active circuits.

Learning Outcome Indicators include:

6.1 Perform conversions in and among number systems such as hexadecimal, decimal, octal, binary, and binary-coded decimal.
6.2 Collaborate to analyze and troubleshoot circuits that have programmable logic devices.
6.3 Collaborate to analyze and troubleshoot combinational logic circuits, sequential logic circuits, and analog-to-digital and digital-to-analog conversion circuits.
6.4 Apply Ohm's Law and Kirchhoff's Laws to circuit analysis.
6.5 Apply superposition and Thevenin's theorems to analyze AC and DC circuits.
6.6 Identify, select, and apply passive components in AC and DC circuits to fulfill job requirements and functional specification.
6.7 Collaborate to analyze resistance, inductance, and capacitance circuits.
6.8 Identify, analyze, and distinguish waveform properties.
6.9 Identify and select analog semi-conducting devices to meet job requirements and functional specifications.
6.10 Build, test, and troubleshoot electrical and electronic circuits.

EMTN07 Control Systems

- Test, install, and troubleshoot a variety of mechanical, electrical, and electronic control systems.

Learning Outcome Indicators include:

7.1 Troubleshoot analog and digital sensors.
7.2 Apply knowledge of electric motor fundamentals to control systems.
7.3 Apply electromechanical knowledge to single- and three-phase industrial and domestic electrical distribution.
7.4 Collaborate to analyze and modify control processes.
7.5 Collaborate to integrate controls and machinery.
7.6 Utilize, adjust, and maintain instrumentation.
7.7 Collaborate to integrate a variety of industrial components with programmable logic controls.
7.8 Test, apply, install, and troubleshoot PLC systems.
7.9 Build, test, and troubleshoot motor controls applying knowledge of control relays and drives.
7.10 Build, test, and troubleshoot mechanical systems applying principles of mechanics.
7.11 Build, test, and troubleshoot pneumatic circuits.
7.12 Build, test, and troubleshoot hydraulic components and systems.
7.13 Resolve efficiency, power loss, and energy problems in electrical and hydraulic

systems.
7.14 Test and measure fluid pressures and flow characteristics.
7.15 Test electrical, electronic, and mechanical controls used in electrical and fluid power systems.
7.16 Collaborate to integrate motion controls.
7.17 Collaborate to integrate electronic control equipment into typical small computer-integrated manufacturing work cell environments so that overall system performs to specification.

EMTN08 Computer Hardware

- Support electromechanical engineering environment through installing and troubleshooting basic computer hardware and programming.

Learning Outcome Indicators include:
8.1 Configure, install, and troubleshoot industrial communication protocols.
8.2 Resolve routine technical problems applying knowledge of computer systems and application software.
8.3 Maintain effective computer operations applying knowledge of hardware and application software.

EMTN09 Automated Equipment

- Maintain and troubleshoot automated equipment including robotic systems.

Learning Outcome Indicators include:
9.1 Collaborate to analyze effectiveness of robots in a variety of industrial processes.
9.2 Troubleshoot integrated robotic systems.
9.3 Collaborate to test a variety of digital display and recording processes and systems.
9.4 Install and repair automated manufacturing equipment found in manufacturing facilities.
9.5 Apply knowledge of robot programming and operating protocol.

EMTN10 Inventory and Documentation Systems

- Document and maintain inventory, records, and documentation systems.

Learning Outcome Indicators include:
10.1 Prepare technical documentation such as operator procedures, maintenance procedures, repair procedures and installation procedures.
10.2 Apply information from technical manuals.
10.3 Manage electronic and/or paper-based systems to store and retrieve information.
10.4 Maintain current, clear, and accurate electromechanical engineering-related documents.
10.5 Prepare reports using records and inventories.
10.6 Prepare and maintain parts inventory and installation records.

10.7 Prepare and maintain maintenance and service logs.
10.8 Document work processes such as problem-solving methodologies, troubleshooting procedures, and prototype evolution.
10.9 Implement established procedures of inventory control.
10.10 Document design, testing, modification, and application of electrical, electronic, and mechanical equipment and systems.

EMTN11 Specify and Purchase Equipment

- Collaborate to design, specify and purchase electromechanical equipment, components, and systems.

Learning Outcome Indicators include:
11.1 Access and identify potential sources of equipment, components, and systems.
11.2 Collaborate to select and troubleshoot motors and drives.
11.3 Access clients, manufacturers, consultants, and suppliers to obtain information required to select and purchase appropriate equipment, components, and systems.
11.4 Determine requirements and functional specifications of equipment, components, and systems for procurement.
11.5 Collaborate to recommend appropriate equipment, components, and systems.
11.6 Determine adequate substitutes when necessary.
11.7 Access manufacturers' specifications, catalogues, and electronic sources to select equipment, components, and systems.
11.8 Collaborate to research, interpret, collect, and process data necessary to complete purchasing process.
11.9 Recognize the importance of using standardized parts to facilitate troubleshooting and reduce spare parts inventory.

EMTN12 Quality Assurance

- Collaborate in the delivery of quality assurance programs.

Learning Outcome Indicators include:
12.1 Implement maintenance schedules.
12.2 Apply preventive and predictive maintenance techniques.
12.3 Monitor, document, and report compliance with appropriate maintenance procedures and specifications.
12.4 Inspect components using appropriate measuring instruments as required.
12.5 Report test results in accordance with maintenance procedures.
12.6 Apply knowledge of maintenance procedures and programs.
12.7 Apply appropriate procedures, measurement, and testing equipment.
12.8 Configure test equipment to generate appropriate test vectors.

