



## **ELECTRONICS – TECHNOLOGIST (ELOTY 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 Electronics CTS is relevant to programs including, but not limited to, communications, telecommunications, biomedical, mechatronics, avionics, control systems, and electromechanical 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 Electronics 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 equipment or systems; interpretation or preparation of specifications, technical drawings, or instructions; quality management and inspection; project management and contract management; administration; manufacturing operations; field and customer service; estimating; technical sales; supervision of manufacturing; supervision of projects; and training activities.

## Discipline Learning Outcomes (DLOs)

### **ELOTY01 Analog Circuits**

- Diagnose, specify, select, design, and, construct DC and AC analog circuits.

Learning Outcome Indicators include:

- 1.1 Assess requirements and characteristics of analog circuits and clearly summarize these in functional specification for a given application.
- 1.2 Interpret, fundamental operating principles of analog circuits using appropriate mathematics and concepts.
- 1.3 Select and specify analog circuits and components to meet design specifications.
- 1.4 Design analog circuits using knowledge of analog electronics, computer simulation programs, and generic engineering principles.
- 1.5 Evaluate, test and construct analog circuits.
- 1.6 Analyze and resolve analog circuit design and functionality problems.
- 1.7 Diagnose and characterize analogue circuits using test and measurement instrumentation, including spectrum analyzers and oscilloscopes.

### **ELOTY02 Digital Circuits**

- Diagnose specify, select, design construct, and characterize digital circuits.

Learning Outcome Indicators include:

- 2.1 Assess requirements and characteristics of digital systems and clearly summarize these in functional specification.
- 2.2 Interpret fundamental operating principles of digital circuits using appropriate mathematics and concepts.
- 2.3 Select and specify digital components and circuits to meet design specifications.
- 2.4 Design digital circuits using knowledge of digital electronics, computer simulation programs, and generic engineering principles.
- 2.5 Evaluate, test and construct digital circuits.
- 2.6 Analyze and resolve digital circuit design and functionality issues.
- 2.7 Diagnose and characterize digital circuits using test or measurement instrumentation, including logic analyzers and oscilloscopes.
- 2.8 Design, build, and debug VHDL code for use in programmable logic device (PLD) using appropriate programming environment.
- 2.9 Critique, interface, and program PLD to perform specified digital logic functions using appropriate software and hardware.
- 2.10 Diagnose operation of programmed PLD device using appropriate equipment, tools, and techniques.

### **ELOTY03 Communications Systems**

- Diagnose design, specify, construct and characterize communications systems.

Learning Outcome Indicators include:

- 3.1 Assess requirements and characterise communications systems and clearly summarize these in functional specification.
- 3.2 Interpret fundamental operating principles of given communications system using appropriate mathematics and concepts.
- 3.3 Select and specify communication system components and circuits to meet design specifications.
- 3.4 Design communications systems using, knowledge of analog and digital electronics, circuit design, computer simulation programs, computer systems, programming, networking, communications protocols, and general engineering principles.
- 3.5 Evaluate, test, and construct communications circuits and systems, including analysis of communication channel and its effects (e.g., twisted pair wire, coaxial cable, optical fibre, microwave waveguide, and atmospheric or free space propagation path).
- 3.6 Analyze and solve communications systems design and functionality issues.
- 3.7 Diagnose and characterize communication systems using test or measurement instrumentation, including protocol analyzers, spectrum analyzers, communication analyzers meters, signal monitoring and logging tools, and oscilloscopes.
- 3.8 Plan, install, commission, maintain and decommission communications systems, including, antenna and electronics components.

### **ELOTY04 Troubleshooting**

- Diagnose specify, select, and design computer programs using appropriate coding and debugging environments.

Learning Outcome Indicators include:

- 4.1 Create clear functional specification documents given specific application for required program design.
- 4.2 Interpret fundamental operating principles of given computer program using appropriate mathematics and concepts.
- 4.3 Select and specify software tools to meet design specs, including programming language and development environment.
- 4.4 Design computer programs to solve engineering or mathematical problems, according to application requirements and using knowledge, as appropriate, of structured, object-oriented, or GUI (graphic-user interface) programming language and incorporating effective user interface.
- 4.5 Diagnose and analyze program design and functionality issues using appropriate debug environment.
- 4.6 Interpret developed programs using standard commenting and documentation techniques.

## **ELOTY05 Micro-Processor / Micro-Controller**

- Diagnose, specify, select, design, and construct, micro-processor or micro-controller based systems.

Learning Outcome Indicators include:

- 5.1 Create clear functional specification documents given a specific application for microprocessor or microcontroller-based system.
- 5.2 Select and specify computer-related hardware and software to meet design specifications.
- 5.3 Design microprocessor or microcontroller-based systems using knowledge of computer related hardware and software.
- 5.4 Evaluate, test, and construct microprocessor or microcontroller-based systems.
- 5.5 Analyze and resolve microprocessor or microcontroller-based system design and functionality issues.
- 5.6 Design, code, and debug both high-level and assembly language programs using appropriate debug and compile environment for use in microprocessor or microcontroller applications.
- 5.7 Diagnose and characterize microprocessor and microcontroller based systems using test or measurement instrumentation, including logic analyzers and oscilloscopes.
- 5.8 Assess, design, and install interfaces, including A/D and D/A converters, between microprocessor and microcontroller-based systems and with supporting I/O devices.
- 5.9 Model expected behaviour of microprocessor and microcontroller based systems using appropriate hardware emulation tools.

## **ELOTY06 Computer Systems**

- Diagnose, specify, assemble, configure, support, and manage computer systems in stand-alone, networked, or web-based environment.

Learning Outcome Indicators include:

- 6.1 Create clear functional specification documents given a specific application for a computer system.
- 6.2 Select and specify computer hardware, operating system(s), and software to meet design requirements.
- 6.3 Design, test, assemble and configure computers that use a variety of hardware platforms including multiple operating systems using knowledge of computer principles and characteristics, operating systems, and computing requirements.
- 6.4 Analyze and resolve computer system configuration and functionality issues.
- 6.5 Diagnose and characterize computer systems using test or measurement instrumentation and software tools, including system monitoring and diagnostic tools, protocol, and traffic analyzers.
- 6.6 Create, document, and maintain appropriate antivirus and security procedures for computer systems.

- 6.7 Create, document, and maintain backup and recovery plans and procedures for computer systems, including appropriate use of network capabilities.
- 6.8 Maintain and administer computer systems using appropriate operating system administration tools.

### **ELOTY07 Network Security**

- Diagnose, specify, analyze, and administer computer networks for use in secure transmission of data.

Learning Outcome Indicators include:

- 7.1 Create clear functional specification documents for a computer network.
- 7.2 Interpret fundamental operating principles of given computer network at all OSI layers, including physical link, using appropriate mathematics and concepts and with reference to OSI model.
- 7.3 Select and specify network hardware, software, operating systems, and protocols to meet design specifications.
- 7.4 Design computer networks using knowledge of networking principles, characteristics, and requirements.
- 7.5 Configure, and install network connectivity hardware and software (e.g., hubs, routers, switches, and gateways) as part of network implementation.
- 7.6 Plan and implement construction, testing, and evaluation of computer networks.
- 7.7 Analyze and solve computer network design and functionality issues.
- 7.8 Diagnose and characterize computer networks using test or measurement instrumentation and software tools, including protocol analyzers and oscilloscopes.
- 7.9 Configure, and install network servers and server applications using appropriate network operating systems.
- 7.10 Create, document, and maintain antivirus and security procedures for computer networking systems.

### **ELOTY08 Automated Control Systems**

- Diagnose, specify, select, design, construct, and commission automated control systems for industrial applications.

Learning Outcome Indicators include:

- 8.1 Create clear functional specification documents given a specific application for automated control systems.
- 8.2 Interpret fundamental principles of automated control systems using appropriate mathematics and concepts.
- 8.3 Select and specify automated control systems to meet design specifications.
- 8.4 Design automated control systems using knowledge of industrial systems, process control, and generic engineering principles.
- 8.5 Diagnose, test and construct automated control systems.
- 8.6 Analyze and design control systems to function in an integrated environment.

- 8.7 Analyze and resolve automated control system design and functionality issues.
- 8.8 Select and use test or measurement instrumentation, including protocol analyzers and logic analyzers.

### **ELOTY09 Medical Devices and Systems**

- Diagnose, specify, select, design, install, construct, maintain, and repair medical devices and systems, and related test and measurement instruments.

Learning Outcome Indicators include:

- 9.1 Assess requirements and characteristics of biomedical signals and clearly describe the technical-clinical relationship.
- 9.2 Create design specifications and select medical equipment components applying knowledge of engineering principles, standards, regulations, and life sciences.
- 9.3 Select and utilize test and measurement instruments, including bio-signal simulators, defibrillation, NIBP, and safety analyzers.
- 9.4 Evaluate performance of medical devices and systems in order to perform calibration, repair, and maintenance according to regulations and standards of practice.
- 9.5 Apply knowledge of standards of practice in technology management of medical device inventory for improving patient safety and clinical outcomes.
- 9.6 Apply knowledge in engineering, life sciences, and clinical practice, which act as the bridge between clinician and engineer.
- 9.7 Apply principles of system engineering and quality management to increase device utilization and minimize risk.

### **ELOTY10 Avionics Devices and Systems**

- Select and utilize appropriate test and measurement instruments in administration, installation, calibration, maintenance, troubleshooting, and repair of avionics devices and systems.

Learning Outcome Indicators include:

- 10.1 Apply principles of aerodynamics to avionics systems.
- 10.2 Apply standard practices to avionics problems and routines.
- 10.3 Test, calibrate and maintain aircraft instruments.
- 10.4 Interpret and employ aircraft electrical drawings effectively.
- 10.5 Test, calibrate, and install aircraft navigation systems.
- 10.6 Create and maintain proper technical records to NAVCOM standards.
- 10.7 Test, install, commission, and maintain aircraft computers.
- 10.8 Test, install, commission, and maintain autopilot and control systems.
- 10.9 Apply aircraft engines theory to avionic maintenance.

## **ELOTY11 Broadcast Devices and Systems**

- Select and use appropriate test and measurement instruments in installation, operation, calibration, maintenance, troubleshooting, and repair of broadcast devices and systems.

Learning Outcome Indicators include:

- 11.1 Diagnose and specify VCR mechanical and electronic systems.
- 11.2 Diagnose and specify television monitors, antennas, or CATV cabling.
- 11.3 Diagnose and analyze commercial or consumer video recording equipment.
- 11.4 Diagnose probable causes of audio signal problems.
- 11.5 Diagnose probable causes of video and display problems.
- 11.6 Interpret and apply schematic diagrams and service manuals for television receiver and video monitors.
- 11.7 Diagnose and analyze television receiver and video monitor operation.
- 11.8 Diagnose, specify, design, recording, monitoring, and sound processing or sound projection equipment and systems.
- 11.9 Modify and employ control and studio room operations applying appropriate design principles.
- 11.10 Diagnose and manage the maintenance of cable television equipment and systems.
- 11.11 Diagnose, configure, operate, and specify high power radio frequency communication systems.

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