



## **BIOMEDICAL – TECHNOLOGIST (BMTY 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 Biomedical CTS is relevant to programs including, but not limited to, clinical engineering, bionics, medical electronics, and prosthetics, implants and diagnostics 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.

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 Biomedical Engineering Technology - Technologist programs have career opportunities in such areas as: health delivery, industry, 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; administration; manufacturing operations; field and customer service; estimating; technical sales; supervision of projects; and training activities.

## Discipline Learning Outcomes (DLOs)

### **BMTY01 AC and DC Analog Circuits**

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

Learning Outcome Indicators include:

- 1.1 Assess requirements and characteristics of analog circuits and clearly summarize these in functional specifications for a given application.
- 1.2 Interpret fundamental operating principles of an analogue circuit 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, select and characterize analogue circuits using test and measurement instrumentation, including spectrum analyzers and oscilloscopes.

### **BMTY02 Digital Circuits**

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

Learning Outcome Indicators include:

- 2.1 Assess requirements and characteristics of digital systems for an application and clearly summarize these in functional specifications.
- 2.2 Interpret the fundamental operating principles of a digital circuit 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.

### **BMTY03 Computer Systems**

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

Learning Outcome Indicators include:

- 3.1 Create clear functional specification documents for computer systems.
- 3.2 Select and specify computer hardware, operating system(s), and software to meet design requirements.

- 3.3 Test, configure and assemble computers that use a variety of hardware platforms including multiple operating systems using knowledge of computer principles and characteristics, operating systems, and computing requirements.
- 3.4 Analyze and resolve computer system configuration and functionality issues.
- 3.5 Diagnose and characterize computer systems selecting and using test or measurement instrumentation and software tools, including system monitoring and diagnostic tools, protocol, and traffic analyzers.
- 3.6 Create, document, and maintain appropriate antivirus and security procedures for computer systems.
- 3.7 Create, document, and maintain backup and recovery plans and procedures for computer systems, including appropriate use of network capabilities.
- 3.8 Manage and maintain computer systems using appropriate operating system administration tools.

#### **BMTY04 Computer Networks**

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

Learning Outcome Indicators include:

- 4.1 Create clear functional specification documents for computer networks.
- 4.2 Explain fundamental operating principles of given computer networks at all OSI layers including physical links using appropriate mathematics and concepts, with reference to OSI model.
- 4.3 Select and specify network hardware, software, operating systems, and protocols to meet design specifications.
- 4.4 Design computer networks using knowledge of networking principles, characteristics, and requirements.
- 4.5 Configure and install network servers and server applications using appropriate network operating systems.
- 4.6 Create, document, and maintain antivirus and security procedures for computer networking systems.

#### **BMTY05 Medical Devices**

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

Learning Outcome Indicators include:

- 5.1 Assess requirements and characteristics of biomedical signals and clearly describe technical-clinical relationships.
- 5.2 Create design specifications and select medical equipment components applying knowledge of engineering principles, standards and regulations, and life sciences.
- 5.3 Select and utilize test and measurement instruments, including bio-signal simulators, defibrillation, NIBP, and safety analyzers.

- 5.4 Evaluate performance of medical devices and systems in order to perform calibration, repair, and maintenance according to regulations and standards of practice.
- 5.5 Apply knowledge of standards of practice in technology management of medical device inventory for improving patient safety and clinical outcomes.
- 5.6 Apply knowledge of engineering, life science, and clinical practice to act as the bridge between the clinician and engineer.
- 5.7 Apply principles of system engineering and quality management to increase device utilization and minimize risk.

### **BMTY06 Project Management**

- Apply principles of project management.

Learning Outcome Indicators include:

- 6.1 Collect information identifying scope and costs of project.
- 6.2 Identify stages of engineering project and determine criteria necessary for timely completion of project.
- 6.3 Monitor expenditures and maintain cost effective practices.
- 6.4 Schedule, coordinate, and monitor project-related work.
- 6.5 Contribute to long and short-term planning.
- 6.6 Interpret, prepare and review various elements of estimates.
- 6.7 Audit engineering project to assess if goals were met.

### **BMTY07 Standards and Practice in Biomedical Engineering**

- Interpret, specify and apply standards and regulations in the design, development, configuration, and maintenance of medical devices and systems.

Learning Outcome Indicators include:

- 7.1 Explain roles and functions of biomedical engineering technologist and biomedical engineering department in health care environment.
- 7.2 Interpret and apply medical device standards and regulations in the development, configuration, and maintenance of medical devices and systems.
- 7.3 Analyse critically all phases of medical device development and adhere to product development processes in compliance with medical device regulations and quality systems requirements (ISO 13485).
- 7.4 Organize and conduct electrical and mechanical medical device safety tests in accordance with relevant standards and regulations (IEC 60601).
- 7.5 Interpret and apply elements of risk management in the design and use of medical devices and systems (ISO 14971).
- 7.6 Apply a systems approach to technology management.
  - 7.6.1 *Perform cost-of-ownership analysis in medical technology evaluation.*

## **BMTY08 Medical Imaging Equipment**

- Diagnose, select, specify, install, maintain, and repair diagnostic medical imaging equipment and systems.

Learning Outcome Indicators include:

- 8.1 Apply knowledge of engineering principles, radiation physics, human anatomy and physiology, standards, and regulations in specification development, selection, installation, quality assurance, and maintenance of diagnostic medical image equipment and systems, including medical diagnostic x-ray, nuclear medicine, ultrasound, endoscopy, image production, and picture archiving and communication systems.
- 8.2 Select and use tools and equipment in performance testing, calibration, troubleshooting, and repair of medical imaging equipment and systems.
- 8.3 Evaluate performance of medical imaging equipment and systems according to relevant regulations and standards.
- 8.4 Identify potential hazards in diagnostic medical radiology.
  - 8.4.1 *Implement and practice radiation safety and protection measures.*

## **BMTY09 Medical Laboratory Instrumentation**

- Diagnose, select, specify, design, build, install, maintain, and repair diagnostic medical laboratory instrumentation.

Learning Outcome Indicators include:

- 9.1 Apply knowledge of engineering principles, biological chemistry, standards, and regulations in selecting and specifying components for design, quality assurance, and maintenance of diagnostic medical laboratory instrumentation in areas of clinical chemistry, hematology, clinical microbiology, anatomical pathology, and transfusion science.
- 9.2 Select and use tools and equipment.
  - 9.2.1 *Prepare reagents.*
  - 9.2.2 *Diagnose, calibrate and repair diagnostic medical laboratory instrumentation using computer software.*
- 9.3 Evaluate performance of diagnostic medical laboratory instrumentation according to manufacturers' specifications and relevant regulations and standards.
- 9.4 Use laboratory safety devices applying principles of Standard Precautions.
- 9.5 Identify and handle hazardous materials according to existing standards and regulations.

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