GENERAL – TECHNOLOGIST (GLOY2023)

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 General CTS is relevant to all programs at the technologist level.

Definitions

Broadly-defined engineering problems – Broadly-defined engineering problems: a class of problem that cannot be resolved without engineering specialist bodies of knowledge and technologies that provide theoretical frameworks including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations using the technologies of a discipline. For further reference, see International Engineering Alliance ***Graduate Attributes & Professional Competencies***.

Learning Outcomes

This CTS lists General Learning Outcomes (GLO) which describe the significant and essential learning that students have achieved and can reliably demonstrate at the time of graduation. Each GLO 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.

GLO 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 engineering technologist and applied science 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 processes, infrastructure, or systems; interpretation or preparation of specifications, drawings, or instructions; quality management; construction management, construction contract inspection and administration; operations and maintenance; field and customer service; estimating; management and project management; technical sales; supervision of projects; training activities; appropriate attention to hazard identification and health and safety risks; and many other areas.

General Learning Outcomes (GLO)

GY01 Technology Report (Capstone Project)

- Research, design test, analyze, conclude, and defend a Technology Report (Capstone Project) relating to significant technology-related issue.

Learning Outcome Indicators may include:

1.1 Determine a research area where practical technical investigation is warranted and define research goals and objectives.
1.2 Compile and integrate a wide range of research resources, including professionally published or peer reviewed literature, online tools, and interviews.
1.3 Integrate use of technologies specific to discipline, investigate procedures and analyze issues.
1.4 Assemble, analyse, and appropriately apply technical data to create graphics, reports, and other documents.
1.5 Integrate the processing, analysis, and interpretation of technical data to conclude project.
1.6 Compile information effectively and accurately by analysing, translating, and producing the report.
1.7 Justify conclusions and make recommendations.
1.8 Create the Technology Report in professional format using accepted principles of documentation, grammar, writing style, graphics and design.
1.9 Present the Technology Report and respond effectively to questions defending project conclusions.

GY02 Mathematics

- Educational programs must achieve mathematics learning outcomes consistent with discipline requirements, as defined in the chart below.

Discipline	Learning Outcome		
	2.1 Basic Math	2.2 Statistics	2.3 Advanced Math
Architecture/Construction/Building Engineering Technology	✓	✓	✓
Architecture Technology	✓	✓	
Bioscience Technology	✓	✓	
Biomedical Engineering Technology	✓	✓	✓
Chemical Engineering Technology	✓	✓	✓
Chemical Technology	✓	✓	
Civil Engineering Technology	✓	✓	✓
Electrical Engineering Technology	✓	✓	✓
Electronics Engineering Technology	✓	✓	✓
Environmental Engineering Technology	✓	✓	✓
Environmental Technology	✓	✓	
Instrumentation Engineering Technology	✓	✓	✓
Industrial Engineering Technology	✓	✓	✓
Information Technology	✓	✓	
Mechanical Engineering Technology	✓	✓	✓
Mineral Resource Technology	✓	✓	✓
Petroleum Engineering Technology	✓	✓	✓
Renewable Resources Technology	✓	✓	
Survey/Geomatics Engineering Technology	✓	✓	✓

Basic Math

2.1 Analyze and solve engineering technology/applied science problems utilizing algebra, matrix manipulation and introductory calculus.

Learning Outcome Indicators may include:

2.1.1 Analyze and solve technical problems utilizing: algebraic equations, functions, factors, ratios and proportions; conversions and linear regression; trigonometry; plane geometry; exponential and logarithmic functions.

2.1.2 Analyze and solve technical problems plotting mathematical data, and using graphs standard equations and design software.

2.1.3 Analyze and solve technical problems using basic arithmetic operations on scalar and vector products.

2.1.4 Analyze and solve engineering technology/applied science problems applying discrete/finite mathematics, logic systems, and algorithmic functions.

2.1.5 Analyze and solve computer algorithmic problems and programming languages applying the concepts and notations from discrete mathematics.

2.1.6 Analyze and solve technical problems such as evaluating slopes and classifying functions utilizing differential calculus principles.

Statistics

2.2 Analyze and solve engineering technology/applied science problems applying statistics and statistical processes.

Learning Outcome Indicators may include:

2.2.1 Organize data collection specifying sampling methods, collecting, evaluating and reporting statistical data in terms of central tendency and dispersion.
2.2.2 Calculate probabilities, experimental z and t values and correlation coefficients utilizing basic probability techniques.
2.2.3 Analyze sample distributions utilizing normal probability distribution, standard normal curve and central limit theorem.
2.2.4 Compare and analyze distribution and relative frequencies of discrete and continuous random variables.
2.2.5 Conclude confidence intervals for population means.
2.2.6 Determine and/or utilize relationships with respect to sample size and population variability.
2.2.7 Determine differences between two population means, and between two population proportions using p values to indicate significance tests for population means.
2.2.8 Analyze and solve technical problems and linear relationships through the application of the principles of linear regression and correlation.
2.2.9 Analyze and solve quality assurance problems through the application of techniques such as control charting and acceptance sampling.
2.2.10 Develop statistical experimental designs for methods of random sampling with selection of treatments and blocking.
2.2.11 Analyze and solve technical problems utilizing chi-square tests, power and exponential regression, and by formulating and testing hypotheses for type I and type II errors.

Advanced Math

2.3 Analyze and solve engineering technology/applied science problems utilizing advanced algebra, matrix and calculus methodologies.

Learning Outcome Indicators may include:

2.3.1 Analyze and solve technical problems such as utilizing derivatives to evaluate slopes, classify functions, and solve first and second order differential equations.
2.3.2 Analyze and solve first and second order differential equations utilizing Laplace transforms, Fourier transforms, and numerical methods.
2.3.3 Analyze and solve technical problems such as the area under curves, volumes of revolution, length of paths, and first moments of area and Centres of gravity, utilizing integral calculus principles.
2.3.4 Analyze and solve technical problems by applying trapezium or Simpson's rule.

2.3.5 Utilize determinants to solve technical problems involving simultaneous linear equations.
2.3.6 Analyze and solve technical problems through the application of complex numbers.
2.3.7 Analyze and solve technical problems utilizing matrices, performing arithmetic operations and solving simultaneous equations as matrices.
2.3.8 Analyze and solve technical problems through the application of linear programming.
2.3.9 Analyze and solve technical problems involving arithmetic, geometric, Taylors, McLaurin's and other series, evaluating limits of a sequence or series.
2.3.10 Analyze and solve technical problems through the application of advanced techniques of integration.

GY03 Project Management

- Select and apply current industry practices of project management and business principles.

Learning Outcome Indicators may include:

3.1 Develop project charter defining project goals and objectives; description; scope; constraints; metrics; key stakeholders; team composition; schedule; budget and resource allocation.
3.2 Describe relationship between time, costs, and quality elements of a project.
3.3 Evaluate principles of project elements, such as integration, scope, time, cost, quality, communications, personnel, risk and procurement in project of defined scope and stakeholder needs.
3.4 Explain processes associated with initiating and closing out a project.
3.5 Create project plan, of defined scope, implementing various project elements.
3.6 Analyze measures to control changes to scope, schedule, cost, and quality of project.
3.7 Illustrate and document project activities, tasks, and reports.
3.8 Create a project schedule utilizing both a manual method and a computerized method, such as critical path, Gantt chart and/or program evaluation and review techniques such as PERT or similar techniques.
3.9 Examine concepts of quality assurance, continuous improvement and problem solving in managing a project.
3.10 Assess importance of safety and its impact on project management.

GY04 Physical and Natural Science

- Solve technical problems applying the principles of physical and natural science.

Learning Outcome Indicators may include:

4.1 Solve technical problems applying principles of technology physics, of heat, light, and sound.

4.2 Solve technical problems applying principles of one or more of general chemistry, organic, or inorganic chemistry.
4.3 Solve technical problems applying principles of material science and/or physical chemistry.
4.4 Solve technical problems applying principles of electricity and magnetism.
4.5 Solve technical problems applying principles of classical mechanics.
4.6 Develop and demonstrate expertise in experimentation, observation, measurement, and documentation through laboratory experiences.
4.7 Employ and explain safe laboratory practices.

GY05 Ethics, Sustainability, Contracts, and Codes

- Solve engineering technology /applied science problems applying business/management principles, ethics, sustainability, contract law, codes and standards.

Learning Outcome Indicators may include:
5.1 Critique the Professional Provincial Association (PPA) Code of Ethics.
5.2 Identify and explain legal and professional accountabilities in the workplace.
5.3 Identify and resolve social, contractual and environmental project issues applying ethical reasoning.
5.4 Explain and assess the principles of sustainability in an engineering technology/ applied science project.
5.5 Identify and explain the purpose of codes and standards applicable to the discipline.
5.6 Identify and explain basic contracts utilized in the discipline.
5.7 Identify and explain confidentiality and privacy regulations, as well as other pertinent regulatory frameworks and/or compliancy requirements.
5.8 Describe patents, trademarks and intellectual property rights with respect to engineering technology/ applied science practice.
5.9 Identify and explain the impact of technology on society.
5.10 Work effectively as a member of a work /project team
5.11 Maintain equality and unity within ethnic, racial, and cultural diversity of work/project groups.
5.12 Identify and explain business management principles appropriate for the discipline.
5.13 Demonstrate the ability to acquire and apply new knowledge as needed, using appropriate learning strategies for ensuring ongoing professional competence and ethics.

GY06 Communication

- Analyze, access, and document data preparing graphics, charts, drawings, and reports for engineering technology/applied science projects.

Learning Outcome Indicators may include:
6.1 Determine the appropriate source and type of data required and develop appropriate strategies for data collection.

6.2 Organize and conduct the taking of measurements, their recording, and evaluation appropriate for the discipline.
6.3 Interpret and analyze data using systematic approaches to problem solving and decision- making.
6.4 Create sketches and engineering /applied science drawings to accepted industry standards, formats, symbols and reference systems.
6.5 Create process flow charts and schematic diagrams to accepted or industry practice.
6.6 Create plans, drawings, and modelling presentation graphics using computer-aided drafting software to accepted or industry practice.
6.7 Evaluate data relationships for a discipline specific engineering technology/applied science project's interface with its physical environment.
6.8 Create and present project-related documents including reports, using software presentation tools, in oral and written formats, as appropriate for the task as an individual and part of a team.
6.9 Solicit and consider instructions and feedback from stakeholders and other audiences, documenting and communicating findings as required. .
6.10 Identify, explain, and demonstrate the purpose, problems and processes of technical communications in various workplace situations.
6.11 Create graphics, tables, equations, charts, fundamental formulas, and similar outputs employing tools such as word processing, spread sheets, diagramming, and flow charting and other tools appropriate to workplace practices.
6.12 Plan and implement an employment search creating an effective resume and demonstrating proper interview skills.
6.13 Explain and apply the methodology of meeting planning, chairing, and minute taking.

GY07 Computer Knowledge

- Use a variety of appropriate computer hardware and software necessary to the performance of tasks within the discipline.

Learning Outcome Indicators may include:

7.1 Select the appropriate software or other technology for the task, ensure the parameters are correct, and the results are validated.
7.2 Utilize computer operating systems and common application software competently and safely.
7.3 Evaluate and select types of tasks best handled using computers or other technology.
7.4 Analyze the specific task and identify and employ appropriate software, tools and equipment.
7.5 Configure and perform the transfer, back up, and archiving of digital data in a secure manner.
7.6 Organize computer file systems.
7.7 Resolve technical problems using computer software applications common to the discipline.

7.8 Identify, describe and employ the application of computers and computer technology to transfer, research, retrieve information, and share data in a secure and safe manner.
7.9 Identify the attributes of technologies or methodologies, which have been supplanted by computer technologies.

GY08 Health and Safety

- Design, analyze, interpret and assess best practices to ensure a safe and healthy working environment for oneself, colleagues, and the general public, as appropriate by discipline.

Learning Outcome Indicators may include:

8.1 Design, analyze, interpret and assess health and safety best practices applicable to a discipline.
8.2 Develop site/project-specific Health and Safety Plans for an academic institutional site.
8.3 Identify, explain and assess provincially regulated occupational health and safety regulations and first aid program requirements in academic institution environment.
8.4 Explain and evaluate best practices to address specific hazards or unsafe conditions applicable to the discipline including hazardous and designated substances.
8.5 Explain and evaluate legislation to address hazards or unsafe conditions applicable to the discipline including the transportation of dangerous goods.
8.6 Describe health and safety legislation practices and demonstrate their principles with respect to accident prevention and incident investigation.
8.7 Analyze an academic institutional workplace area and apply procedures to manage unsafe or hazardous situations.
8.8 Identify risks to safety and the environment by designing and assessing auditing and assessment techniques to manage and/or mitigate hazards or unsafe conditions.
8.9 Research and assess safe work procedures to operate and maintain workplace equipment safely in a lab or shop environment (including personal protective equipment).
8.10 Identify and assess general health and safety awareness training specific to the discipline (legislated, institutional, and laboratory/workshop specific training).

GY09 Engineering Fundamentals

- Apply knowledge of engineering fundamentals, procedures, processes, systems or methodologies to broadly-defined engineering problems.

Learning Outcome Indicators may include:

9.1 Apply principles in materials and methods of construction, manufacturing or development as determined by the discipline of study.
9.2 Apply principles in design of systems, tools, components, structures or other discipline related requirements.

9.3 Apply principles and experience in measurement techniques and equipment and analysis tools as determined by the discipline of study.
9.4 Apply principles and experience in test protocol and sampling determination as determined by the discipline of study.

GY010 Engineering Tools

- Use a variety of engineering tools necessary to the performance of tasks within the discipline to solve broadly-defined engineering problems.

Learning Outcome Indicators may include:

10.1. Select the appropriate measurement tools for the task and ensure the results are validated.
10.2. Select the appropriate computer-aided design and drafting (CAD tools (2D vs 3D) for the task and ensure the results are validated for further requirements in construction, manufacturing and approval submittal processes.
10.3. Select appropriate machining, manufacturing and forming equipment and processes for the task, ensuring selection is made on best practices and industry requirements.
10.4. Select the appropriate sampling type, quantity and methodology and ensure the results are validated.
10.5. Utilize appropriate simulation tools for the task, evaluate the results and ensure the results are validated.