Ontario

Electronics Engineering Technology Program Standard

The approved program standard for Electronics Engineering Technology programs of instruction leading to an Ontario College Advanced Diploma delivered by Ontario Colleges of Applied Arts and Technology (MTCU funding code 65203)

Ministry of Colleges and Universities
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Introduction

This document is the Program Standard for the Electronics Engineering Technology programs of instruction leading to an Ontario College Advanced Diploma delivered by Ontario Colleges of Applied Arts and Technology (MTCU funding code 65203).

Development of system-wide program standards

In 1993, the Government of Ontario initiated program standards development with the objectives of bringing a greater degree of consistency to college programming offered across the province, broadening the focus of college programs to ensure graduates have the skills to be flexible and to continue to learn and adapt, and providing public accountability for the quality and relevance of college programs.

The Program Standards Unit of the Ministry of Colleges and Universities has responsibility for the development, review and approval of system-wide standards for programs of instruction at Ontario Colleges of Applied Arts and Technology.

Program standards

Program standards apply to all similar programs of instruction offered by Colleges of Applied Arts and Technology across the province of Ontario. Each program standard for a postsecondary program includes the following elements:

- **Vocational standard** (the vocationally specific learning outcomes which apply to the program of instruction in question),
- **Essential employability skills** (the essential employability skills learning outcomes which apply to all programs of instruction); and
- **General education requirement** (the requirement for general education in postsecondary programs of instruction).

Collectively, these elements outline the essential skills and knowledge that a student must reliably demonstrate in order to graduate from the program.

Individual Colleges of Applied Arts and Technology offering the program of instruction determine the specific program structure, delivery methods and other curriculum matters to be used in assisting students to achieve the outcomes articulated in the standard. Individual colleges also determine whether additional local learning outcomes will be required to reflect specific local needs and/or interests.

The expression of program standards as vocational learning outcomes

Vocational learning outcomes represent culminating demonstrations of learning and achievement. They are not simply a listing of discrete skills, nor broad statements of knowledge and comprehension. In addition, vocational learning outcomes are interrelated and cannot be viewed in isolation from one another. As such, they should be viewed as a comprehensive whole. They describe performances that demonstrate that significant integrated learning by graduates of the program has been achieved and verified.

Expressing standards as vocational learning outcomes ensures consistency in the outcomes for program graduates, while leaving to the discretion of individual colleges, curriculum matters such as the specific program structure and delivery methods.

The presentation of the vocational learning outcomes

The **vocational learning outcome** statements set out the culminating demonstration of learning and achievement that the student must reliably demonstrate before graduation.

The **elements of the performance** for each outcome define and clarify the level and quality of performance necessary to meet the requirements of the vocational learning outcome. However, it is the performance of the vocational learning outcome itself on which students are evaluated. The elements of performance are indicators of the means by which the student may proceed to satisfactory performance of the vocational learning outcome. The elements of performance do not stand alone but rather in reference to the vocational learning outcome of which they form a part.

The development of a program standard

In establishing the standards development initiative, the Government determined that all postsecondary programs of instruction should include vocational skills coupled with a broader set of essential skills. This combination is considered critical to ensuring that college graduates have the skills required to be successful both upon graduation from the college program and throughout their working and personal lives.

A program standard is developed through a broad consultation process involving a range of stakeholders with a direct interest in the program area, including employers, professional associations, universities, secondary schools and program graduates working in the field, in addition to students, faculty and administrators at the colleges themselves. It represents a consensus of participating stakeholders on the essential learning that all program graduates should have achieved.

Updating the program standard

The Ministry of Colleges and Universities will undertake regular reviews of the vocational learning outcomes for this program to ensure that the Electronics Engineering Technology Program Standard remains appropriate and relevant to the needs of students and employers across the Province of Ontario. To confirm that this document is the most up-to-date release, please contact the Ministry of Colleges and Universities.

Vocational standard

All graduates of Electronics Engineering Technology programs have achieved the thirteen vocational learning outcomes (VLOs), in addition to achieving the essential employability outcomes and meeting the general education (GE) requirement.

Preamble

Graduates of Electronics Engineering Technology programs carry out electronics engineering functions within an engineering environment. Graduates have demonstrated achievement of vocational learning outcomes which relate to engineering in general and electronics engineering in particular.

The vocational learning outcomes and their respective elements of performance were articulated to clearly define the range and level of skills, knowledge and attitudes required by graduates in order to be successful as entry-level electronics engineering technologists. Achievement of the vocational learning outcomes will prepare the graduates of the Electronics Engineering Technology programs to **design**, **analyze**, **troubleshoot** and commission, as well as to modify, maintain and repair electronic circuits, devices, equipment, components, systems and subsystems. In addition, graduates will be able to contribute to management functions, project management, **quality control** and **quality assurance** programs, and to apply communication, documentation, information technology, computer applications, teamwork and leadership skills to support an organization’s safe, electronics related activities.

Graduates of Electronics Engineering Technology programs work in a broad range of employment settings. Their jobs may involve working with industrial, scientific and medical instruments, avionics and networks including network security and computer networks, and a variety of electronic systems, such as telecommunication systems, broadcast systems, embedded systems, wireless systems and control systems.

Students' learning is significantly enhanced by opportunities to gain and reflect on as much practical experience as is feasible during their studies. This program standard has identified a cluster of common skills, knowledge and attitudes essential to all entry-level employees in the electronics engineering field; however, individual colleges may choose to build on this standard by offering some degree of specialization.

There may be opportunities for graduates to pursue further educational and occupational qualifications; through articulation agreements between the colleges, universities or professional organizations, graduates may be granted credits towards a degree or certification. Students should contact individual colleges for further details of a college's articulation agreements with other institutions or professional associations.

See Glossary

Note: The Ontario Council on Articulation and Transfer (ONCAT) maintains the provincial postsecondary credit transfer portal, ONTransfer.

Synopsis of the vocational learning outcomes

Electronics Engineering Technology (Ontario College Advanced Diploma)

The graduate has reliably demonstrated the ability to:

1. Modify, **design** and produce electrical and electronics drawings, layouts and reports using appropriate technology to communicate accurate technical information, and to complete project requirements.

2. Perform and generate procedures to test electrical and/or electronic circuits, equipment and systems in accordance with relevant operational guidelines and standards.

3. **Design**, build and **troubleshoot** electronic circuits, equipment, and systems in accordance with task requirements, **functional specifications** and relevant standards.

4. Modify, maintain, repair, calibrate and recommend electronic equipment and systems in accordance with relevant operational guidelines.

5. Determine, select, recommend and justify the purchase of electronic equipment, components and systems in accordance with codes, standards, task requirements and functional **specifications**.

6. **Design**, construct, modify, **analyze** and **troubleshoot** digital logic circuits, embedded systems, programmable logic devices, and digital signal processing applications using industry specific software tools and programming languages to ensure their functional operation.

7. **Design**, **analyze** and build circuits consisting of various components using industry specific tools, techniques and measurements to meet project objectives.

8. **Design**, **analyze** and **troubleshoot** control systems using industry specific methods to optimize their operation.

9. **Analyze**, **troubleshoot**, maintain and repair telecommunication systems in accordance with standards and guidelines to ensure their effective operation.

10. Comply with health and safety guidelines and procedures in accordance with best practices and relevant regulations.

11. Collaborate in selecting, co-ordinating and conducting **quality control** and **quality assurance** programs and procedures in accordance with standards and guidelines.

12. Complete work in compliance with relevant legislation, established standards, codes, policies, procedures and regulations, and sustainability best practices and ethical principles.

13. Apply project management principles and tools when responding to requirements and monitoring projects within an electronics engineering environment to ensure timely completion of a project.

See Glossary

Note: The learning outcomes have been numbered as a point of reference; numbering does not imply prioritization, sequencing, nor weighting of significance.

The vocational learning outcomes

1. The graduate has reliably demonstrated the ability to: modify, **design** and produce electrical and electronics drawings, layouts and reports using appropriate technology to communicate accurate technical information, and to complete project requirements.

Elements of the performance

a. Assemble relevant information, data and materials.
b. Interpret, upgrade and maintain schematics, assembly drawings, related **functional specifications** and relevant standards.
c. Produce and modify engineering drawings with appropriate standards and symbols using computer aided design (CAD) tools.
d. Produce project-related documents.
e. Interpret, simulate, **design** and create drawings, sketches and related graphics.
f. Organize, write and prepare technical reports, business letters, memos and emails, using appropriate technology.
g. Use terminology suited to different types of situations and the persons involved.
h. Create and review functional **specifications** for electronic equipment and systems, with guidance as required.
i. Use database management, word processing, spreadsheet, graphics and communication software applications – including mechanical **design** and drafting programs, electronics schematic capture, layout and documentation programs – to design effective sketches, diagrams, charts, tables and graphs.

See Glossary

2. The graduate has reliably demonstrated the ability to: perform and generate procedures to test electrical and/or electronic circuits, equipment and systems in accordance with relevant operational guidelines and standards.

Elements of the performance

a. **Analyze** electrical and/or electronic problems and apply established engineering practice to determine practical solutions.
b. Use a variety of resources, including colleagues, industry-approved manuals and handbooks, manufacturer's technical experts and the Internet to generate and perform test procedures that comply with industry and government standards.
c. Perform procedures to test electrical and/or electronic circuits, equipment and systems, and troubleshoot in compliance with standards, procedures, policies and practices of electronics engineering, established by technical associations, government and regulatory bodies.
d. Select, implement, set up and calibrate test equipment for the accurate assessment of electrical and/or electronic equipment and system performance.
e. Recognize when to request additional resources.
f. Evaluate and propose solutions
g. Identify and apply the functional requirements of test equipment.
h. Identify and apply relevant standards, when appropriate, e.g. Canadian Standards Association (CSA), Conformite Europeenne (CE), Underwriters' Laboratories (UL) and China Compulsory Certification (CCC).
i. **Analyze** and solve technical problems related to electronics engineering by applying principles of advanced mathematical concepts.
j. Conduct, or specify tests on electronic circuits, and document and interpret test results, as required.

See Glossary

3. The graduate has reliably demonstrated the ability to: **design**, build and **troubleshoot** electronic circuits, equipment, and systems in accordance with task requirements, **functional specifications** and relevant standards.

Elements of the performance

a. Determine or develop, when necessary, task requirements and **functional specifications** of electronic circuits.
b. Design, build, modify, **troubleshoot** and recommend improvements to electronic circuits, in accordance with task requirements, **functional specifications**, assembly guidelines, engineering drawings and applicable safety standards.
c. Handle and store electronic components and equipment according to manufacturer's specifications, such as thermal and electrostatic discharge (ESD) requirements.
d. Document electronic circuit evolution (e.g., problems, modifications, lessons learned).
e. Utilize risk assessment techniques to determine any potential danger areas.
f. **Design** and fabricate printed circuit board (PCB) assemblies and associated electronic packaging such as cabinetry, heatsinking and interconnections.
g. Repair sub-assemblies and replace electronic components using knowledge of appropriate through-hole and surface mount technologies.
h. Develop, install, and maintain software, in accordance with task requirements, **functional specifications**, installation guidelines, and industry standards.

See Glossary

4. The graduate has reliably demonstrated the ability to: modify, maintain, repair, calibrate and recommend electronic equipment and systems in accordance with relevant operational guidelines.

Elements of the performance

a. Install, configure and commission equipment and systems.
b. Select and use standard test equipment and verify correct operation.
c. Connect standard test equipment to devices to monitor data acquisition and/or control.
d. Maintain, repair, and calibrate equipment to standard, and develop and follow a regular service schedule.
e. Modify equipment when appropriate and ensure equipment inspection by the Electrical Safety Authority (ESA) when required.
f. Operate equipment in accordance with **functional specifications** and established practices, policies and procedures.
g. Comply with health and safety legislation while operating electronic equipment.

See Glossary

5. The graduate has reliably demonstrated the ability to: determine, select, recommend and justify the purchase of electronic equipment, components and systems in accordance with codes, standards, task requirements and **functional specifications**.

Elements of the performance

a. Contact clients, manufacturers, consultants and suppliers to obtain information required to determine, select, recommend and justify the purchase of appropriate electronic equipment, components and systems.
b. Determine and recommend for purchase the requirements **and functional specifications** of electronic equipment, components and systems by consulting manufacturers' specifications as well as print and electronic media.
c. Determine and recommend adequate substitutes when appropriate.
d. Prepare and evaluate quotes on purchased electronic equipment, components or systems.
e. Apply related **quality assurance** principles and standards to the purchase and verification of material.

See Glossary

6. The graduate has reliably demonstrated the ability to: **design**, construct, modify, **analyze** and **troubleshoot** digital logic circuits, embedded systems, programmable logic devices, and digital signal processing applications using industry specific software tools and programming languages to ensure their functional operation.

Elements of the performance

a. Perform conversions and calculations in and among number systems, such as hexadecimal, decimal, binary and binary-coded decimal.
b. Recognize logic family characteristics in digital circuits for **troubleshooting** tasks.
c. **Design**, simulate, **analyze** and **troubleshoot** combinational and sequential logic circuits as well as analog-to-digital and digital-to-analog conversion circuits.
d. Produce, interpret and use timing diagrams to **analyze** and **troubleshoot** sequential logic circuits.
e. **Design**, **analyze**, **troubleshoot** and modify circuits which have programmable logic devices, including those using graphical or hardware description languages, e.g. Very High-Speed Integrated Circuit Hardware Description Language (VHDL).
f. **Design**, **analyze** and **troubleshoot** circuits with embedded systems and write code in low and high level languages.
g. **Design**, **analyze** and **troubleshoot** embedded systems interface and interfacing circuitry.
h. **Design, analyze** and **troubleshoot** routines in low and high-level languages using structured programming techniques and software tools.
i. **Design, analyze** and **troubleshoot** computing hardware, peripherals and bus architectures.
j. **Analyze** and **troubleshoot** computer network hardware and related software.

See Glossary

7. The graduate has reliably demonstrated the ability to: **design**, **analyze** and build circuits consisting of various components using industry specific tools, techniques and measurements to meet project objectives

Elements of the performance

a. Apply Ohm's Law, mesh and nodal analyses and Kirchhoff's Laws to circuit **design** and **analysis**.
b. Apply superposition, Thevenin's Theorem and Norton's Theorem to **design** and **analyze** alternating current (AC) and direct current (DC) circuits
c. Identify, select, recommend and apply passive components in AC/DC circuits to fulfill **functional specifications**.
d. Solve phasor and complex number problems related to electrical and electronic circuits.
e. Identify, **analyze** and distinguish waveform properties.
f. Design, **analyze**, build and **troubleshoot** passive AC/DC (RLC) circuits in compliance with relevant standards.
g. Perform real and apparent power calculations on devices and circuits.
h. Design and simulate circuits consisting of passive components.
i. Design and analyze passive circuits by using prototyping boards effectively.
j. Apply knowledge of resonance to the design and analysis of circuits.
k. Identify performance limitations by applying reliability principles and recommend improvements if required.
l. Identify and select active low power and high power, discrete and integrated devices in accordance with task requirements and **functional specifications**.
m. Apply the principles of operation of low power and high power, discrete and integrated devices to the design, **analysis**, simulation and **troubleshooting** of simple and complex electronic circuits.
n. **Design**, **analyze**, build and **troubleshoot** electronic circuits and subsystems incorporating active devices and electromechanical sensors and actuators, such as motors.
o. Perform measurements on high power, discrete, integrated and electromechanical circuits to determine operational limits such as power dissipation and safety requirements, and to **design** and/or recommend the appropriate strategies.
p. Apply knowledge of polyphase AC systems to electronic circuit **design** and **analysis**.
q. **Design**, **analyze**, build and **troubleshoot** components, such as mechanical relays, solid state relays, transistors, thyristors, optocouplers, in a power system.

See Glossary

8. The graduate has reliably demonstrated the ability to: **design**, **analyze** and **troubleshoot** control systems using industry specific methods to optimize their operation.

Elements of the performance

a. **Design**, **analyze** and **troubleshoot** control and feedback systems in compliance with task requirements and **functional specifications**.
b. **Design**, simulate, **analyze**, and troubleshoot control processes using computer-based tools, according to relevant standards.
c. Perform measurements and modifications on control systems.
d. Characterize and calibrate sensors and actuators and apply the derived transfer functions for **troubleshooting** or optimizing control systems using appropriate methods.
e. **Design**, create, modify and maintain control system documentation, such as manuals, drawings and bill of materials.
f. Use, tune and apply algorithms such as the proportional-integral-derivative (PID) algorithm, in single loop control systems.

See Glossary

9. The graduate has reliably demonstrated the ability to: **analyze**, **troubleshoot**, maintain and repair telecommunication systems in accordance with standards and guidelines to ensure their effective operation.

Elements of the performance

a. Install, configure and commission equipment within analog and digital communication systems, including computer networks and wireless systems, in compliance with relevant standards and regulations.
b. Apply principles and select components of telecommunication systems for the purpose of **design**, maintenance, and repair.
c. Review available information, conduct relevant tests on equipment, interpret and **analyze** test results and **troubleshoot** as required.
d. Operate electronics and other equipment in compliance with **functional specifications** and safety procedures.
e. Relate principles of Internet Protocol (IP) to the transfer of information within a telecommunication system.
f. Recommend a regular service schedule.
g. Comply with health and safety legislation.
h. Apply transmission line theory to determine appropriate communications media required to transmit a given telecommunications signal over a distance.
i. **Design**, **analyze**, construct and **troubleshoot** Radio Frequency (RF) (including microwave) circuits, equipment and systems.
j. Implement local-area networks (LAN) and wide-area networks (WAN) using appropriate networking devices.
k. **Analyze** and **troubleshoot** communication protocols and identify their applications.
l. Identify noise sources and apply filtering techniques.
m. Comply with legislation and regulations governing the transmission and reception of radio signals.
n. Apply basic concepts related to satellite communications.
o. Select appropriate media for a particular communication system.
p. **Design**, **analyze** and **troubleshoot** communication protocols, including the identification of noise sources and the application of noise-control techniques.

See Glossary

10. The graduate has reliably demonstrated the ability to: comply with health and safety guidelines and procedures in accordance with best practices and relevant regulations.

Elements of the performance

a. Interpret and apply safety codes, policies and practices, and accident prevention procedures.
b. Use protective equipment and wear appropriate clothing to ensure personal health and safety in the workplace.
c. Select the appropriate tools and operate and maintain them safely.
d. Conduct safety inspections of various work environments to detect and correct hazardous conditions.
e. Install, maintain and repair electronic equipment in accordance with regulatory and licensing requirements.
f. Handle, store and dispose hazardous materials safely in accordance with the Workplace Hazardous Materials Information System (WHMIS)
g. Apply proper procedures to handle electronic components, such as Electrostatic Discharge (ESD).
h. Comply with relevant health and safety standards by identifying and reporting non-compliance issues.
i. Identify and apply relevant standards, when appropriate, e.g. Canadian Standards Association (CSA), Conformité Européenne (CE), Underwriters' Laboratories (UL) and China Compulsory Certification (CCC).

See Glossary

11. The graduate has reliably demonstrated the ability to: collaborate in selecting, co-ordinating and conducting **quality control** and **quality assurance** programs and procedures in accordance with standards and guidelines.

Elements of the performance

a. Produce and review functional **specifications** and test procedures applicable to electronic equipment, and perform these test procedures.
b. Perform quality **assurance** testing or ensure that **quality assurance** is completed for electronics manufacturing processes and verify standards compliance.
c. Monitor, evaluate and report test results in compliance with organizational **quality assurance** procedures and **functional specifications**.
d. Interpret, **analyze**, and apply necessary **quality assurance** problem solving functions to manufacturing or quality monitoring processes, and determine resulting improvements.
e. Develop, select and use appropriate procedures for electronics test and electronics measurement equipment.
f. Configure and/or automate test equipment to generate appropriate test vectors.
g. **Design**, install, configure and commission electronic testing equipment and circuits to enable quality control and quality assurance functions.
h. Create or recommend a calibration, service and preventive maintenance schedule for electronic equipment and circuits.
i. Indicate the importance of and apply knowledge of recognized quality standards, e.g. International Organization for Standardization (ISO 9001).
j. Prepare and maintain an inventory of parts and installation records as required by the business, taking into account expiry dates where applicable, and keep inventory records up to date.
k. Prepare installation records and update maintenance and service logs, and document compliance, as required.
l. Apply computerized maintenance management system software to facilitate the process of maintenance operations and inventory of parts, when appropriate.
m. Assist in applying the concepts of statistical process control with respect to manufacturing processes.
n. Apply the fundamental concepts of product and inventory control.
o. Apply verification, validation, **quality control** and **quality assurance** to electronics engineering functions, for example the design of electronic circuits.

See Glossary

12. The graduate has reliably demonstrated the ability to: complete work in compliance with relevant legislation, established standards, codes, policies, procedures and regulations, and sustainability best practices and ethical principles.

Elements of the performance

a. Recognize legal principles affecting contracts with clients.
b. Interpret and comply with projects' **functional specifications** and drawings.
c. Act in accordance with legislation, codes and appropriate industry standards, including occupational health and safety and labour laws.
d. Use equipment and materials which adhere to relevant legislation, standards, codes and bylaws including environmental responsibilities, Ontario Electrical Safety Code, Canadian Electrical Code, IEEE, etc.
e. Follow practices that comply with relevant legislation, standards, codes and bylaws, including environmental responsibilities, Ontario Electrical Safety Code, Canadian Electrical Code, IEEE, etc.
f. Promote contributions of technology for the betterment of society.
g. Conduct safety inspections of various work environments to detect, report and correct hazardous conditions, where they may occur.
h. Practice ethical principles, including support for equity, diversity and inclusion in the workplace.
i. Assume responsibility and accountability.
j. Identify training courses, workshops and programs to enhance knowledge of legislation, standards, policies, procedures, codes, regulations and ethical principles as well as other professional topics.
k. Recognize and act accordingly on procedures and practices that are non-compliant with legislation, standards, codes, regulations and ethical principles.
l. Assess the life cycle of electronic products using appropriate principles and environmental responsibilities, such as e-waste.

See Glossary

13. The graduate has reliably demonstrated the ability to: apply project management principles and tools when responding to requirements and monitoring projects within an electronics engineering environment to ensure timely completion of a project.

Elements of the performance

a. Participate in the planning, identification, scheduling and assigning of tasks and resources involved in a project as required.
b. Contribute to the monitoring of resources and expenditures to maintain cost effectiveness and respect timelines as required.
c. Produce and consolidate project reports and updates, as requested.
d. Provide reasonable estimates for the time required to complete project elements.
e. Complete project elements according to schedule, identify problems which will affect the project timeline and recommend changes as soon as possible.
f. Contribute to the pre and post evaluation of project processes and outcomes.
g. Use project management software to produce and maintain project planning documents (e.g., Gantt Charts, Critical Path Analysis, PERT Charts), as required.
h. Maintain current, clear and accurate project-related documents, which adhere to organizational and industry standards and procedures.
i. Contribute to the management of changing requirements throughout the life cycle of a project.

See Glossary

Glossary

Advanced mathematical concepts: concepts that include differential and integral calculus, series expansion, differential equations, Laplace, complex numbers, Fourier and Z-Transform analyses* to solve technical problems, etc.

Analyze: collect information by studying the characteristics of electronic circuits, equipment or systems to understand how elements are affecting one another.

Design/Designing: the devising and creating of drawings, circuits or systems from fundamental concepts or components using established reference design and related documentation. This includes the ability to apply critical thinking to provide appropriate recommendations.

Functional specifications - document that specifies the functions that a system or component must perform and is often part of a requirements specification. (Adapted from ISO/IEC/IEEE 24765:2017)

Quality assurance: all the planned and systematic activities implemented within the quality system that can be demonstrated to provide confidence that a product or service will fulfill requirements for quality.

Quality control: the operational techniques and activities, including documentation, used to fulfill requirements for technical quality.

Troubleshoot/Troubleshooting: determine why electronic circuits, equipment, systems or sub-systems are malfunctioning, and propose solutions so that the problem is solved and the equipment is functional.

Essential employability skills

All graduates of the Electronics Engineering Technology program of instruction must have reliably demonstrated the essential employability skills learning outcomes listed below, in addition to achieving the vocational learning outcomes and meeting the general education requirement.

Context

Essential Employability Skills (EES) are skills that, regardless of a student's program or discipline, are critical for success in the workplace, in day-to-day living and for lifelong learning.

The teaching and attainment of these EES for students in, and graduates from, Ontario's Colleges of Applied Arts and Technology are anchored in a set of three fundamental assumptions:

- these skills are important for every adult to function successfully in society today;
- our colleges are well equipped and well positioned to prepare graduates with these skills;
- these skills are equally valuable for all graduates, regardless of the level of their credential, whether they pursue a career path, or they pursue further education.

Skill categories

To capture these skills, the following six categories define the essential areas where graduates must demonstrate skills and knowledge.

- Communication
- Numeracy
- Critical Thinking & Problem Solving
- Information Management
- Interpersonal
- Personal

Application and implementation

In each of the six skill categories, there are a number of defining skills, or sub skills, identified to further articulate the requisite skills identified in the main skill categories. The following chart illustrates the relationship between the skill categories, the defining skills within the categories and learning outcomes to be achieved by graduates from all postsecondary programs of instruction that lead to an Ontario College credential.

EES may be embedded in General Education or vocational courses or developed through discrete courses. However, these skills are developed, all graduates with Ontario College credentials must be able to reliably demonstrate the essential skills required in each of the six categories.

Skill category: communication

Defining skills

Skill areas to be demonstrated by graduates:

- reading
- writing
- speaking
- listening
- presenting
- visual literacy

Learning outcomes

The graduate has reliably demonstrated the ability to:

1. communicate clearly, concisely and correctly in the written, spoken and visual form that fulfills the purpose and meets the needs of the audience.
2. respond to written, spoken or visual messages in a manner that ensures effective communication.

Skill category: numeracy

Defining skills

Skill areas to be demonstrated by graduates:

- understanding and applying mathematical concepts and reasoning
- analyzing and using numerical data
- conceptualizing

Learning outcomes

The graduate has reliably demonstrated the ability to:

1. execute mathematical operations accurately

Skill category: critical thinking and problem solving

Defining skills

Skill areas to be demonstrated by graduates:

- analyzing
- synthesizing
- evaluating
- decision making
- creative and innovative thinking

Learning outcomes

The graduate has reliably demonstrated the ability to:

1. apply a systematic approach to solve problems.
2. use a variety of thinking skills to anticipate and solve problems.

Skill category: information management

Defining skills

Skill areas to be demonstrated by graduates:

- Gathering and managing information
- Selecting and using appropriate tools and technology for a task or a project
- Computer literacy
- Internet skills

Learning outcomes

The graduate has reliably demonstrated the ability to:

1. locate, select, organize and document information using appropriate technology and information systems.
2. analyze, evaluate and apply relevant information from a variety of sources.

Skill category: interpersonal

Defining skills

Skill areas to be demonstrated by graduates:

- Teamwork
- Relationship management
- Conflict resolution
- Leadership
- Networking

Learning outcomes

The graduate has reliably demonstrated the ability to:

1. show respect for the diverse opinions, values, belief systems and contributions of others.
2. interact with others in groups or teams in ways that contribute to effective working relationships and the achievement of goals.

Skill category: personal

Defining skills

Skill areas to be demonstrated by graduates:

- Managing self
- Managing change and being flexible and adaptable
- Engaging in reflective practices
- Demonstrating personal responsibility

Learning outcomes

The graduate has reliably demonstrated the ability to:

1. manage the use of time and other resources to complete projects.
2. take responsibility for one's own actions, decisions and their consequences.

General education requirement

All graduates of the Electronics Engineering Technology program must have met the general education requirement described below, in addition to achieving the vocational and essential employability skills learning outcomes.

Requirement

The General Education Requirement for programs of instruction is stipulated in the Credentials Framework (Appendix A in the Minister's Binding Policy Directive Framework for Programs of Instruction).

In programs of instruction leading to either an Ontario College Diploma or an Ontario College Advanced Diploma, it is required that graduates have been engaged in learning that exposes them to at least one discipline outside their main field of study and increases their awareness of the society and culture in which they live and work. This will typically be accomplished by students taking 3 to 5 courses (or the equivalent) designed discretely and separately from vocational learning opportunities.

This general education learning would normally be delivered using a combination of required and elective processes.

Purpose

The purpose of General Education in the Ontario college system is to contribute to the development of citizens who are conscious of the diversity, complexity and richness of the human experience; who are able to establish meaning through this consciousness; and who, as a result, are able to contribute thoughtfully, creatively and positively to the society in which they live and work.

General Education strengthens students' essential employability skills, such as critical analysis, problem solving and communication, in the context of an exploration of topics with broad-based personal and/or societal importance.

Themes

The themes listed below will be used to provide direction to Ontario Colleges in the development and identification of courses that are designed to fulfil the General Education Requirement for programs of instructions.

Each theme provides a statement of Rationale and offers suggestions related to more specific topic areas that could be explored within each area. These suggestions are neither prescriptive nor exhaustive. They are included to provide guidance regarding the nature and scope of content that would be judged as meeting the intent and overall

goals of General Education.

Arts in society:

Rationale:

The capacity of a person to recognize and evaluate artistic and creative achievements is useful in many aspects of his/her life. Since artistic expression is a fundamentally human activity, which both reflects and anticipates developments in the larger culture, its study will enhance the student's cultural and self-awareness.

Content:

Courses in this area should provide students with an understanding of the importance of visual and creative arts in human affairs, of the artist's and writer's perceptions of the world and the means by which those perceptions are translated into the language of literature and artistic expression. They will also provide an appreciation of the aesthetic values used in examining works of art and possibly, a direct experience in expressing perceptions in an artistic medium.

Civic Life:

Rationale:

In order for individuals to live responsibly and to reach their potential as individuals and as citizens of society, they need to understand the patterns of human relationships that underlie the orderly interactions of a society's various structural units. Informed people will have knowledge of the meaning of civic life in relation to diverse communities at the local, national and global level and an awareness of international issues and the effects of these on Canada, as well as Canada's place in the international community.

Content:

Courses in this area should provide students with an understanding of the meaning of freedoms, rights and participation in community and public life, in addition to a working knowledge of the structure and function of various levels of government (municipal, provincial, national) in a Canadian and/or in an international context. They may also provide an historical understanding of major political issues affecting relations between the various levels of government in Canada and their constituents.

Social and cultural understanding:

Rationale:

Knowledge of the patterns and precedents of the past provide the means for a person to gain an awareness of his or her place in contemporary culture and society. In

addition to this awareness, students will acquire a sense of the main currents of their culture and that of other cultures over an extended period of time in order to link personal history to the broader study of culture.

Content:

Courses in this area are those that deal broadly with major social and cultural themes. These courses may also stress the nature and validity of historical evidence and the variety of historical interpretation of events. Courses will provide the students with a view and understanding of the impact of cultural, social, ethnic or linguistic characteristics.

Personal Understanding:

Rationale:

Educated people are equipped for life-long understanding and development of themselves as integrated physiological and psychological entities. They are aware of the ideal need to be fully functioning persons: mentally, physically, emotionally, socially, spiritually and vocationally.

Content:

Courses in this area will focus on understanding the individual: his or her evolution; situation; relationship with others; place in the environment and universe; achievements and problems; and his or her meaning and purpose. They will also allow students the opportunity to study institutionalized human social behaviour in a systematic way. Courses fulfilling this requirement may be oriented to the study of the individual within a variety of contexts.

Science and technology:

Rationale:

Matter and energy are universal concepts in science, forming a basis for understanding the interactions that occur in living and non-living systems in our universe. Study in this area provides an understanding of the behaviour of matter that provides a foundation for further scientific study and the creation of broader understanding about natural phenomena.

Similarly, the various applications and developments in the area of technology have an increasing impact on all aspects of human endeavour and have numerous social, economic and philosophical implications. For example, the operation of computers to process data at high speed has invoked an interaction between machines and the human mind that is unique in human history. This and other technological developments have a powerful impact on how we deal with many of the complex questions in our

society.

Content:

Courses in this area should stress scientific inquiry and deal with basic or fundamental questions of science rather than applied ones. They may be formulated from traditional basic courses in such areas of study as biology, chemistry, physics, astronomy, geology or agriculture. As well, courses related to understanding the role and functions of computers (e.g., data management and information processing) and assorted computer-related technologies should be offered in a non-applied manner to provide students with an opportunity to explore the impact of these concepts and practices on their lives.

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