Ontario College of Teachers
Ordre des enseignantes et des enseignants de l'Ontario

Additional Qualification Course Guideline Teaching Technological Design – Robotics and Control System Design

Schedule F
Teachers' Qualifications Regulation

December 2014

Ce document est disponible en français sous le titre *Ligne directrice du cours menant à la qualification additionnelle Technologie du design – Robotique et système de commande*, décembre 2014.

Additional Qualification Course Guideline

1. Introduction

The guideline for Teaching Technological Design – Robotics and Control System Design is organized using the following framework.

Diagram 1: Guideline Organization

Teachers are able to take the Additional Qualification course: Teaching Technological Design – Robotics and Control System Design if they hold a technological education qualification at Grades 9 and 10 or Grades 11 and 12 in the broad-based area of Teaching Technological Design.

The Additional Qualification Course: Teaching Technological Design – Robotics and Control System Design employs a critical, pedagogical lens to explore in holistic and integrated manner theoretical foundations, development of learners, program planning and implementation, instructional practices, assessment and evaluation, the learning environment and ethical considerations related to teaching and learning.

The Ontario College of Teachers recognizes that candidates working in the publicly funded school system, independent/private institutions or First Nations schools will have a need to explore topics and issues of particular relevance to the context in which they work or may work.

Critical to the implementation of this course is the creation of positive learning experiences that reflect care, diversity and equity. This course supports the enhancement of professional knowledge, ethical practice, leadership and ongoing learning.

The French language and the English language communities will also need to implement these guidelines to reflect the unique contextual dimensions and needs of each community. Each of these language communities will explore the guideline content from distinct perspectives and emphasis. This flexibility will enable both language communities to implement Teaching Technological Design – Robotics and Control System Design as understood from a variety of contexts.

The Teaching Technological Design – Robotics and Control System Design additional qualification course guideline provides a conceptual framework for providers and instructors to develop and facilitate the Teaching Technological Design – Robotics and Control System Design course. The guideline framework is intended to be a fluid, holistic and integrated representation of key concepts associated with Teaching Technological Design – Robotics and Control System Design.

2. Regulatory Context

The College is the self-regulating body for the teaching profession in Ontario. The College's responsibility related to courses leading to additional qualifications includes the following:

- to establish and enforce professional standards and ethical standards applicable to members of the College
- to provide for the ongoing education of members of the College
- to accredit additional qualification courses or programs and more specifically,

  The program content and expected achievement of persons enrolled in the program match the skills and knowledge reflected in the College's Standards of Practice for the Teaching Profession and the Ethical Standards for the

Teaching Profession and in the program guidelines issued by the College. (*Accreditation of Teacher Education Programs Regulation*, Part IV, Subsection 24).

Additional qualifications for teachers are identified in the *Teachers' Qualifications Regulation*. This regulation includes courses/programs that lead to Additional Qualifications, the Principal's Qualifications and the Supervisory Officer's Qualifications. A session of a course leading to an additional qualification shall consist of a minimum of 125 hours as approved by the Registrar. Accredited additional qualification courses reflect the *Ethical Standards for the Teaching Profession,* the *Standards of Practice for the Teaching Profession* and the *Professional Learning Framework for the Teaching Profession.*

The course developed from this guideline is open to candidates who meet the entry requirements identified in the *Teachers' Qualifications Regulation*.

Successful completion of the course leading to the Additional Qualification: Teaching Technological Design – Robotics and Control System Design, listed in Schedule F of the *Teachers' Qualifications Regulation* is recorded on the Certificate of Qualification and Registration. Successful completion of three schedule F courses within a specific broad-based technology area will be deemed to be equivalent to one specialist or honour specialist qualification for purposes of entry into the principal's qualification or the supervisory officer qualification. (O. Reg. 176/10 S.49 (4) and (5))

In this document, all references to candidates are to teachers enrolled in the additional qualification course. References to students indicate those enrolled in school programs.

3. Foundations of Professional Practice

The *Foundations of Professional Practice* conveys a provincial vision of what it means to be a teacher in Ontario. This vision lies at the core of teacher professionalism. The *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession* (Appendix 1) are the foundation for the development and in the realization of the Additional Qualification course. These nine standards, as principles of professional practice, provide the focus for ongoing professional learning and are the foundation for the development and implementation of the Additional Qualification Course:

Teaching Technological Design – Robotics and Control System Design. In addition, the *Professional Learning Framework for the Teaching Profession* is underpinned by the standards, articulates the principles on which effective teacher learning is based and acknowledges a range of options that promote continuous professional learning. The ongoing enhancement of informed professional judgment, which is acquired through the processes of lived experience, inquiry, and reflection, is central to the embodiment of the standards and the Professional Learning Framework within this AQ course and professional practice.

The *Ethical Standards of the Teaching Profession* and the *Standards of Practice for the Teaching Profession* serve as guiding frameworks that underpin professional knowledge, skills and experiences that teachers require in order to teach effectively within and contribute to an environment that fosters *respect, care, trust* and *integrity.*

Teacher-Education Resources

The College has developed resources to support the effective integration of the standards within Additional Qualification courses and programs. These teacher education resources explore the integration of the standards within professional practice through a variety of educative, research and inquiry-based processes. This guideline has been designed to reflect the *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession*and the *Professional Learning Framework for the Teaching Profession*.These resources can be found on the College web site (www.oct.ca). These resources support the development of professional knowledge and professional judgment through reflective practice. The lived experiences of Ontario educators are illuminated in the resources and serve as AQ course support for teacher education.

4. Conceptual Framework

The design, course content and implementation of the Additional Qualification Course Guideline: Teaching Technological Design – Robotics and Control System Design support effective teacher education practices. These course guideline components provide a conceptual framework for the development of a holistic, integrated, experiential and inquiry-based course. The following conceptual framework supports and informs professional knowledge, judgment and practices within the Additional Qualification Course: Teaching Technological Design – Robotics and Control System Design.

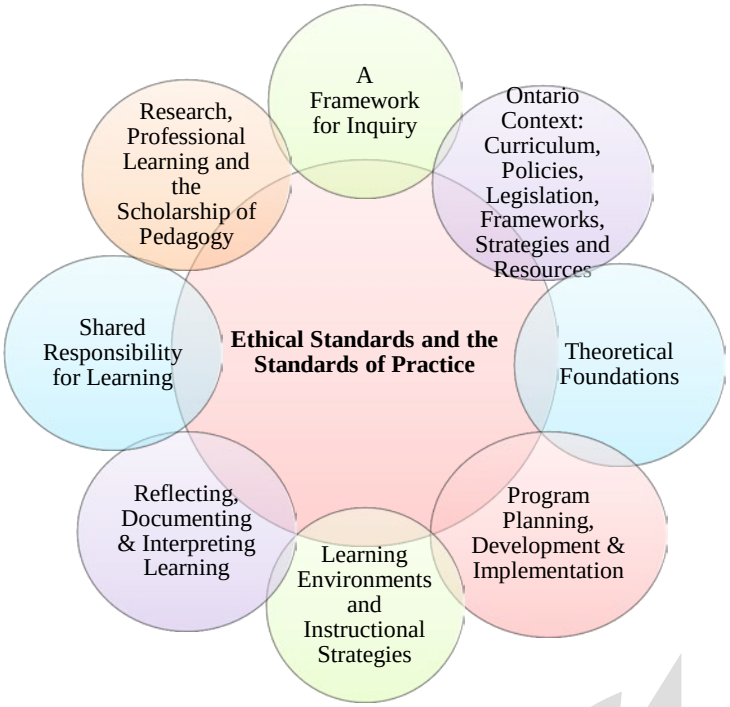

Diagram 2: Conceptual Framework for Teaching Technological Design – Robotics and Control System Design

A. The *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession*:

The *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession* represent a collective vision of professional practice. At the heart of a strong and effective teaching profession is a commitment to students and their learning. Members of the Ontario College of Teachers, in their position of trust, demonstrate responsibility in their relationships with students, parents, guardians, colleagues, educational partners, other professionals, the environment and the public.

The holistic integration of the standards within all course components supports the embodiment of the collective vision of the teaching profession that guides professional knowledge, learning, and practice. The following principles and concepts support this holistic integration within the AQ course.

- understanding and embodying care, trust, respect and integrity
- fostering commitment to students and student learning
- integrating professional knowledge
- enriching and developing professional practice
- supporting leadership in learning communities
- engaging in ongoing professional learning.

Through professional dialogue, collaborative reflection and an ethical culture, course candidates will continue to critically inquire into and refine professional practice and ethical culture through the lens of the *Standards of Practice for the Teaching Profession*.

B. A Framework for Inquiry

The *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession* are embedded throughout the Additional Qualification course guideline.

This Additional Qualification course supports critical reflective inquiry and dialogue informed by the following:

- analyzing, interpreting and implementing Ontario's curriculum, district school board policies, frameworks, strategies and guidelines related to the Broad Based Technology
- developing awareness of First Nations, Métis and Inuit ways of knowing and perspectives
- extending theoretical understanding to design, implement and assess practices and/or programs
- implementing pedagogical strategies and assessment and evaluation practices that are linked to expectations, meet the individual needs of students, and promote student learning
- creating holistic learning environments conducive to the intellectual, social, emotional, physical, linguistic, cultural, spiritual and moral development of students

- working collaboratively with school personnel, parents/guardians, caregivers, the community, local business and industry as it relates to Teaching Technological Design – Robotics and Control System Design
- exercising leadership in accessing a variety of resources, including technological resources, within and beyond the educational system to enhance and support student learning
- refining professional practice through ongoing collaborative inquiry, dialogue and reflection
- modelling ethical practices and addressing ethical issues
- critically exploring and integrating environmentally sustainable practices
- fostering responsible, active environmental citizenship
- collaboratively developing and sustaining professional learning communities for enhancing professional knowledge and supporting student learning
- fostering leadership in the integration of information and communication technology to enhance teaching and learning
- critically exploring innovative strategies to create and sustain safe, healthy, equitable and inclusive learning environments that honour and respect diversity and foster student learning
- understanding the importance of critically examining qualitative and quantitative research related to professional practice
- critically exploring strategies to understand, gain insight into and support learners' well-being and mental health needs
- working collaboratively with interdisciplinary school teams to develop and implement Individual Education Plans (IEPs) of students
- exploring strategies that contribute to a culture that promotes openness to innovation and change
- demonstrating an awareness of emerging technologies related to Teaching Technological Design – Robotics and Control System Design
- demonstrating an awareness of health and safety risks associated with Teaching Technological Design – Robotics and Control System Design
- applying knowledge and skills to create and maintain a safe learning environment that addresses program needs: curriculum, material handling, tool handling and equipment storage, supervision, safety standards and practices that are respectful of the environment

- demonstrating technological literacy related to Teaching Technological Design – Robotics and Control System Design
- writing technical reports and creating and managing portfolios
- demonstrating mathematical literacy in Teaching Technological Design – Robotics and Control System Design
- demonstrating an understanding of business management and entrepreneurial practices related to Teaching Technological Design – Robotics and Control System Design
- inquiring into practice through reflection, active engagement and collaboration
- understanding the various professional practices and career opportunities in Teaching Technological Design – Robotics and Control System Design
- critically exploring the relationship between education, mental health and well-being
- identifying ways to modify expectations, instructional strategies and assessment practices in Teaching Technological Design – Robotics and Control System Design.

C. Ontario Context: Curriculum, Policies, Legislation, Frameworks, Strategies and Resources

The Additional Qualification Course: Teaching Technological Design – Robotics and Control System Design is aligned with current Ontario curriculum, relevant legislation, government policies, frameworks, strategies and resources. These documents inform and reflect the development and implementation of the Additional Qualification Course: Teaching Technological Design – Robotics and Control System Design and can be viewed at www.edu.gov.on.ca.

Course candidates are also encouraged to critically explore the policies, practices and resources available at school and board levels that inform teaching and learning related to Teaching Technological Design – Robotics and Control System Design.

D. Theoretical Foundations of Teaching Technological Design – Robotics and Control System Design

- understanding theories of student development (social, emotional, physical, intellectual, linguistic, cultural, spiritual and moral)
- understanding Ontario curriculum, resources and government policies, frameworks and strategies related to Teaching Technological Design – Robotics and Control System Design
- understanding learning theories and the particular learning needs of the adolescent in the Intermediate and Senior Divisions
- critically exploring a variety of conceptual frameworks related to Teaching Technological Design – Robotics and Control System Design
- reflecting on teaching practice and engaging in professional dialogue regarding the relationship between theory and practice
- integrating the *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession* as the foundation for teacher professionalism within the Additional Qualification Course: Teaching Technological Design – Robotics and Control System Design
- critically exploring the significance of relevant legislation including the Ontario Human Rights Code, Ontarians with Disabilities Act, and the Accessibility for Ontarians with Disabilities Act (AODA) and associated responsibilities within professional practice
- recognizing teachers' legal obligations and ethical responsibilities according to current provincial legislation
- critically inquiring into the dimensions associated with creating and sustaining safe learning environments
- critically exploring holistic and inclusive educational programs that build on learners' abilities and empower them to reach their learning goals
- critically exploring problem solving processes, methods and approaches as they relate to Teaching Technological Design – Robotics and Control System Design
- critically exploring the fundamental technological concepts in Teaching Technological Design – Robotics and Control System Design.

E. Program Planning, Development and Implementation

- applying the *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession* to inform a program planning framework

- critically exploring the influence of society's diverse and changing nature on student learning and well-being
- deepening understanding of program planning, development, implementation strategies and frameworks related to Teaching Technological Design – Robotics and Control System Design
- deepening understanding of differentiated instruction, universal design and the tiered approach in program planning, development and implementation
- critically exploring learning resources (for example, print, visual, digital) that support student learning
- understanding the types of secondary school pathways (including apprenticeship, college, university, workplace) and their relationship to students' post-secondary goals and career opportunities
- critically exploring how students' lived experiences, development, strengths, interests and needs can inform program planning, development and implementation
- integrating culturally responsive pedagogy within program planning and development
- critically exploring strategies that support learners' well-being and mental health needs
- planning instructional strategies that integrate students' learning styles, strengths and experiences
- demonstrating leadership in implementing local and provincial guidelines and policies that support safe and effective learning environments
- inspecting and reporting on the learning environment, facilities, equipment needs, resources and state of maintenance and repair for delivering Teaching Technological Design – Robotics and Control System Design
- applying the theoretical foundations of Teaching Technological Design – Robotics and Control System Design by incorporating the broad-based pedagogical approach that embeds problem solving and the fundamental technological concepts
- identifying the safe, ethical and legal use of technology in Teaching Technological Design – Robotics and Control System Design programs
- critically exploring and integrating multiple formal and informal assessment methods and data to inform program planning and support student learning.

F. Learning Environments and Instructional Strategies

- creating and sustaining positive, ethical, equitable, accepting and safe learning environments
- critically exploring strategies for fostering a collaborative community of empowered learners
- fostering engaging, trusting and inviting learning environments that promote student voice, leadership, critical inquiry and self-regulation
- critically exploring a variety of instructional strategies to support student learning
- developing strategies to create a positive and collaborative learning environment to support student learning
- cultivating safe, ethical and respectful practices in the use of technology in purposeful and legal ways
- integrating information and communication technologies that support student learning
- providing leadership in adapting instruction to meet the needs of all learners
- critically exploring strategies that engage students as active citizen in supporting environmental, social and economic sustainability
- using pedagogies that reflect the professional identity of educators as described in the *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession* and in the *Foundations of Professional Practice*
- creating inclusive learning environments that reflect the ethical standards and standards of practice
- implementing safe and effective management of a variety of technical learning environments
- planning, organizing and implementing effective health, safety, sanitation and environmental standards in the Teaching Technological Design – Robotics and Control System Design facility
- demonstrating an understanding of facility design and maintenance practices as per industry standards

- understanding and complying with workplace health and safety legislation and standards related to Teaching Technological Design – Robotics and Control System Design.

G. Reflecting, Documenting and Interpreting Learning

- collaboratively integrating fair and equitable, transparent, valid and reliable assessment and evaluation methods that honour the dignity, emotional wellness and cognitive development of all students
- critically exploring and collaboratively integrating assessment, evaluation and reporting practices that align with the principles and processes of Ontario's curriculum, frameworks and policy documents
- using assessment for the following three purposes: to provide feedback to students and to adjust instruction (assessment for learning); to develop students' capacity to be independent, autonomous learners (assessment as learning); to make informed judgements about the quality of student learning (assessment of learning)
- critically exploring the use of baseline data as well as current assessment data to reflect on how the students are progressing and the effectiveness of the learning strategies used.

H. Shared Responsibility for Learning

- critically exploring and collaboratively integrating a variety of effective communication and engagement strategies for authentic collaboration with parents/guardians, school/board personnel and community agencies
- critically exploring and engaging in strategies and opportunities for professional collaboration that supports student learning and well-being
- collaboratively designing programs that address biases, discrimination and systemic barriers in order to support student learning, well-being and inclusion
- fostering and sustaining a positive, inclusive educational culture in which all perspectives are encouraged, valued and heard
- understanding and respecting the importance of shared responsibility and partnership as conveyed in the standards and the Foundations of Professional Practice

- developing strategies to establish links between the school community, industry and the Teaching Technological Design – Robotics and Control System Design program
- critically exploring sector-specific learning opportunities in other curriculum areas
- critically exploring professional collaboration within interdisciplinary teams to support student learning, self-advocacy and transitions.

I. Research, Professional Learning and the Scholarship of Pedagogy

- critically exploring past, present and evolving practices in Teaching Technological Design – Robotics and Control System Design
- critically exploring professional practice through ongoing inquiry into theory and pedagogy/andragogy
- engaging in professional learning through research, scholarship and leadership
- integrating research and the scholarship of pedagogy/andragogy into teaching practice
- collaborating in research and the scholarship of pedagogy/andragogy
- critically exploring knowledge-creation and mobilization as professional practice.

5. Instructional Practice in the Additional Qualification Course: Teaching Technological Design – Robotics and Control System Design

Candidates will collaboratively develop with course instructors the specific learning inquiries, learning experiences, and forms of assessment and evaluation that will be used throughout the course.

In the implementation of this Additional Qualification course, instructors use strategies that are relevant, meaningful and practical in providing candidates with learning experiences about instruction, pedagogy and assessment and evaluation. These include but are not limited to: experiential learning, small group

interaction; action research; presentations; independent inquiry; problem solving; collaborative learning and direct instruction.

Instructors model the *Ethical Standards of the Teaching Profession* and the *Standards of Practice for the Teaching Profession*, honour the principles of adult learning, recognize candidates' experience and prior learning and respond to individual needs. Important to the course are opportunities for candidates to create support networks and receive feedback from colleagues and instructors and share the products of their learning with others. Opportunities for professional reading, reflection, dialogue and expression are also integral parts of the course.

Instructors model effective instructional and assessment strategies that can be replicated or adapted in a variety of classroom settings.

A. Experiential Learning

Candidates will be provided with opportunities to engage in experiential learning related to key concepts and aspects of Teaching Technological Design – Robotics and Control System Design as collaboratively determined by both the instructor and course candidates. The intent of the experiential learning opportunities is to support the application and integration of practice and theory within the authentic context of teaching and learning. Candidates will also engage in critical reflection and analysis of their engagement in experiential learning opportunities related to Teaching Technological Design – Robotics and Control System Design. The professional judgment, knowledge and pedagogy of candidates will be enhanced and refined through experiential learning and inquiry.

The College's standards resources help to support experiential learning through various forms of professional inquiry.

6. Assessment and Evaluation of Candidates

At the beginning of the course, candidates will collaboratively develop with course instructors the specific learning inquiries, learning experiences, and forms of assessment and evaluation that will be used throughout the course. Instructors will provide opportunities for regular feedback regarding candidates' progress throughout the course.

A balanced approach to candidate assessment and evaluation is used. It includes the combination of candidate self and peer assessment, as well as instructor evaluation. The assessment and evaluation strategies reflect effective, collaborative and inquiry-based practices. A variety of assessment approaches will be used that enable candidates to convey their learning related to course inquiries. The course provides opportunities for both formative and summative assessment and evaluation.

Central to candidates enrolled in Additional Qualification courses is the opportunity to be engaged in relevant and meaningful inquiries. Assignments, artefacts and projects enable candidates to make connections between theory and practice. At the same time, assignments must allow candidates flexibility, choice and individual inquiry opportunities.

Part of the evaluation process may include a major independent project or action research component over the duration of the course. This project is an opportunity for candidates to illustrate a high level of professional knowledge, communication skills, pedagogy, ethical practices and instructional leadership. Similarly, if a portfolio assignment is used it will also include reflections and analysis of a candidate's learning over time.

A final culminating experience in the course is recommended. This experience may take the form of a written assessment, a research paper, a performance, an inquiry project or a product that is original, meaningful and practical.

The following list of assessment strategies which are reflective of experiential learning is not exhaustive; it is intended to serve as a guide only.

a) Performance assessment: designing a sample unit which includes a culminating activity and appropriate assessment and evaluation tools, incorporates a variety of technologies and resources relevant to the study of Teaching Technological Design – Robotics and Control System Design, and is based on Ministry of Education expectations

b) Written assignment: reflecting critically on issues arising from articles, publications, research and/or other resources related to the teaching or practice to Teaching Technological Design – Robotics and Control System Design

c) Presentation: developing a digital story, presenting an issue related to the teaching and learning related to Teaching Technological Design – Robotics and Control System Design

d) Portfolio: creating a portfolio of practical resources, artefacts, photographs and recording critical reflections for one or several components related to Teaching Technological Design – Robotics and Control System Design

e) Action research: engaging in action research by reflecting and acting upon a specific inquiry into teaching practice related to Teaching Technological Design – Robotics and Control System Design

f) Independent project: addressing any aspect of the course that is approved by the instructor

g) Instructional resource: developing a meaningful resource that will support instruction and pedagogy related to the teaching and learning of Teaching Technological Design – Robotics and Control System Design

h) Reflective writing: reflecting on professional practice through journal-writing, or writing a case or vignette that will support instruction and pedagogy related to the teaching and learning of Teaching Technological Design – Robotics and Control System Design

i) Case inquiry: writing or exploring a case related to collaboration and shared partnerships, with parents, colleagues, and community organizations

j) IEP development: collaboratively develop an IEP related to Teaching Technological Design – Robotics and Control System Design with the family, student and school team

k) Facilitating a Learning Experience: developing and implementing an engaging learning experience that reflects differentiated instruction and universal design and the tiered approach.

7. Demonstrated Knowledge and Skill in Teaching Technological Design – Robotics and Control System Design

Successful candidates will be able to demonstrate technical knowledge and skill in the following:

Technological Design Fundamentals

Design Process

Be able to describe:

- a systematic approach to problem solving
- purpose of designing/building
- effect on society and fit into the environment
- design criteria – based on client/end user
- a problem solving model to include reverse engineering
- components, criteria, and constraints for design briefs (for example, client needs, sustainable design, economics)
- design processes for production
- safety awareness in an industrial environment
- components, criteria, and constraints for design briefs in different mechanical and industrial design areas (for example, System/Components Design, Work Cell Design, design and development of various control systems, devices and equipment
- design for ease of manufacturing and assembly.

Research, Investigation and Information Gathering

Be able to identify:

- a variety of research tools and resources used to generate design ideas (for example, professional archives, websites, catalogues, Ontario Electrical Code, Canadian Electrical Code, Machinists Handbook, ISO 9001 Standards)
- historical periods/industrial revolution and influences on robotics and control systems design using various sources (for example, websites, printed literature, apps)
- technological concepts and methods that relate to robotics and control systems design (for example, Using Project management tools and techniques to breakout tasks in order of operation within given timelines,

Tracking Work Progress, Tracking Resources/Employees, Ongoing Project Monitoring, Critical path analysis, GANTT charts, time sheets)

- specific roles of each member within the design team.

Be able to interpret:

- data of essential design criteria from various sources (for example, codes, laws and regulations that relate to selecting the best materials for the prototype and strength of materials).

Design Development

Be able to describe:

- brainstorming
- conceptualization
- freehand sketching
- 3D concept sketching
- sketching types and techniques (for example, pencil sketches using oblique, isometric or perspective, 2D or 3D views).

Be able to identify:

- rendering software (for example, Google SketchUP), techniques and standards
- simple animations
- simple timing charts to prove out concept.

Technological Design Drafting

Be able to describe:

- drafting instruments and techniques
- standard measurement tools (for example, Vernier calipers, Micrometer, Tape Measure Ruler/Scale).

Be able to identify and interpret:

- technical drawing principles
- 2D and 3D design and drawing principles
- orthographic projections
- assembly drawings
- standards: Canadian Standards Association (CSA)
- electrical wiring techniques and practices for advanced control systems
- electronics techniques and practices for advanced control systems
- pneumatic hosing techniques and practices
- computer control techniques and practices for advanced control systems.

Types of Drawings

Be able to identify and interpret:

- blueprint, technical / mechanical drawings and specifications (for example, of shop drawings, assembly drawings, plan and detail drawings)
- processes and methods in creating a bill of materials
- electrical drawings and conventions
- control drawings (for example, Electo / Mechanical / Pneumatic).

Models

Be able to identify:

- types of models (for example, computer animation models)
- physical prototype build
- reverse engineering models
    - model materials and methods of construction
    - modeling robots and work cells
- computer aided drafting software (for example, Inventor, Solid Edge, Solid Works, 3D AutoCAD, Google Sketchup)

- animation software
- automation software for advanced control systems (programmable logic controller)
- problem solving – analysis – modification strategies.

Reports, Presentations, Portfolios

Be able to demonstrate an understanding of:

- report types
- presentation types, methods, techniques and tools
- project binders
    - functional description
    - mechanical design/drawings
    - electrical design/drawings
    - control design drawings
    - pneumatic design drawings
- presentation drawings
- final report/summary of project – group reflection/journal
- portfolio types (for example, traditional , social media, web sites)
- appropriate methods of visually presenting design solutions (for example, sample board, concept board, formal presentation boards) including the level of professionalism required.

Project Management

Be able to demonstrate an understanding of:

- project management
- bill of materials
- cost analysis
- marketing/project proposal.

Technological Design & the Environment

Be able to describe:

- environmental issues that influence robotic design and the control system industry (for example, LED indicators)
- methods of advocating for energy conservation and other resource conservation when designing a product or process
- methods to reduce waste by the manufacturer and use of products
- research and compare technological eras.

Technological Design & Society

Be able to describe:

- technological eras and societal needs that influence these eras
- economic and cultural issues that influence robotic and control systems design
- societal issues that influence robotic and control systems.

Professional Practice & Technological Design

Be able to identify:

- health and safety certifications related to mechanical and industrial design (for example, First Aid Training, Workplace Hazardous Materials Information System [WHMIS])
- organizations and agencies that regulate, promote and test products and processes related to architectural design (for example, Canadian Standards Association [CSA], Occupational Health and Safety Act [OHSA])
- personal protective equipment (PPE) necessary for in mechanical and industrial design and the construction industry (for example, safety eye, foot and head protective gear).

Career Opportunities In Technological Design

Be able to identify:

- a variety of career opportunities related to robot design and control systems industry (for example, Robotics Technical/Technologist, Mechanical Engineering Technician/Technologist Engineer, Industrial Engineer)
- pathways to skilled trades
- a variety of University Degrees (for example, Mechanical Systems Engineering, Civil Engineering Technology, Electrical Engineering Technology Technician, Manufacturing Engineering Technology, Robotics, Mechanical Engineering Technology Automated Manufacturing)
- career pathways in mechanical and Industrial design related occupations (for example, obtain a degree from an accredited institute, achieve 5600 hours of work experience/ internship, fulfill other licensing or registration requirements)
- job market types and trends in mechanical and Industrial design (for example, full/part time employment, contract, freelance, self-employment, remote work)
- associations, guilds, unions and other professional groups connected with Robotics and Control Systems (for example, Heating, Refrigeration and Air Conditioning Institute of Canada [HRAI], Society of Automotive Engineers [SAE], Society of Women Engineers, Association of Consulting Engineers of Canada [ACEC], Canadian Academy of Engineering [CAE], Canadian Society of Professional Engineers [CSPE], Engineering Institute of Canada [EIC]).

Technological Design Skills

Design Process

Be able to apply:

- the design process as it relates to robotics and control systems design.

Research, Investigation and Information Gathering

Be able to use:

- a variety of research tools and resources (for example, internet, reference materials, technical journals, past projects) and strategies to gather, organize and interpret design information from appropriate resources
- resources from bodies and governing agencies to make design decisions (for example, Ontario Electrical Code, Canadian Electrical Code, Machinists Handbook)
- resources from professional organizations or associations to generate and influence design ideas.

Graphic Representation using Design and Drafting Standards

Be able to use:

- freehand sketches to brainstorm initial design concepts for a project
- mathematical and scientific concepts and skills as required in the course in designing project
- hand drawn or CAD based working drawings and other technical drawings of design solutions using industry recognized drafting standards and conventions
- informal or initial methods to convey design ideas (for example, sketches, renderings)
- formal schematics to confirm designs (for example, mechanical or electrical plans [CAD wiring layout]).

Be able to apply:

- units of measurement and scale when creating designs (for example, metric or imperial, 1:50)
- problem solving models into design concepts.

Model and Prototype Making

Be able to use:

- various tools and materials to create physical models (for example, CNC – Computer Numerical Controlled Machinery such as Mill, Lathe, Router and Non CNC machines such as Bandsaw, Mitre Saw, Chop Saw, Drill Press)
- hand tools/power tools
- programmable logic controller and software
- robot controller and software.

Be able to create:

- prototypes and working models through design ideas (for example, virtual, theoretical and/or functional prototypes).

Be able to demonstrate:

- appropriate use of metric / imperial measuring tools.

Reporting and Presenting

Be able to create and deliver:

- reports and presentations in formats found in robotics and control systems design (for example, scope of work, cost estimates/analysis, technical report)
- presentations advocating for and marketing of design decisions (for example, using proper oral and body language techniques to deliver a multimedia presentation to client)
- complete records of work and design achievements (for example, design package, professional portfolio) while following copyright and patent policies).

Project Management

Be able to develop and use:

- project management strategies and tools to project the outcome of the project, timelines and final outcome
- an evaluation rubric and first steps

- an awareness of how to assess/evaluate products or processes on the basis of student developed criteria.

Professional Practice & Technological Design

Be able to use:

- personal protective equipment (PPE) found in robot design and control system industry (for example, CSA approved safety boots, hard hats, safety glasses)
- proper handling, and storage of tools (for example, metal sheers, soldering gun).

Appendix 1

The *Ethical Standards for the Teaching Profession*

The *Ethical Standards for the Teaching Profession* represent a vision of professional practice. At the heart of a strong and effective teaching profession is a commitment to students and their learning. Members of the Ontario College of Teachers, in their position of trust, demonstrate responsibility in their relationships with students, parents, guardians, colleagues, educational partners, other professionals, the environment and the public.

The Purposes of the Ethical Standards for the Teaching Profession are:

- to inspire members to reflect and uphold the honour and dignity of the teaching profession
- to identify the ethical responsibilities and commitments in the teaching profession
- to guide ethical decisions and actions in the teaching profession
- to promote public trust and confidence in the teaching profession.

The Ethical Standards for the Teaching Profession are:

Care
The ethical standard of *Care* includes compassion, acceptance, interest and insight for developing students' potential. Members express their commitment to students' well-being and learning through positive influence, professional judgment and empathy in practice.

Respect
Intrinsic to the ethical standard of *Respect* are trust and fair-mindedness. Members honour human dignity, emotional wellness and cognitive development. In their professional practice, they model respect for spiritual and cultural values, social justice, confidentiality, freedom, democracy and the environment.

Trust
The ethical standard of *Trust* embodies fairness, openness and honesty. Members' professional relationships with students, colleagues, parents, guardians and the public are based on trust.

Integrity
Honesty, reliability and moral action are embodied in the ethical standard of *Integrity*. Continual reflection assists members in exercising integrity in their professional commitments and responsibilities.

The *Standards of Practice for the Teaching Profession*

The *Standards of Practice for the Teaching Profession* provide a framework of principles that describes the knowledge, skills, and values inherent in Ontario's teaching profession. These standards articulate the goals and aspirations of the profession. These standards convey a collective vision of professionalism that guides the daily practices of members of the Ontario College of Teachers.

The Purposes of the Standards of Practice for the Teaching Profession are:

- to inspire a shared vision for the teaching profession
- to identify the values, knowledge and skills that are distinctive to the teaching profession
- to guide the professional judgment and actions of the teaching profession
- to promote a common language that fosters an understanding of what it means to be a member of the teaching profession.

The Standards of Practice for the Teaching Profession are:

Commitment to Students and Student Learning
Members are dedicated in their care and commitment to students. They treat students equitably and with respect and are sensitive to factors that influence individual student learning. Members facilitate the development of students as contributing citizens of Canadian society.

Professional Knowledge
Members strive to be current in their professional knowledge and recognize its relationship to practice. They understand and reflect on student development, learning theory, pedagogy, curriculum, ethics, educational research and related policies and legislation to inform professional judgment in practice.

Professional Practice
Members apply professional knowledge and experience to promote student learning. They use appropriate pedagogy, assessment and evaluation, resources and technology in planning for and responding to the needs of individual students and learning communities. Members refine their professional practice through ongoing inquiry, dialogue and reflection.

Leadership in Learning Communities
Members promote and participate in the creation of collaborative, safe and supportive learning communities. They recognize their shared responsibilities and their leadership roles in order to facilitate student success. Members maintain and uphold the principles of the ethical standards in these learning communities.

Ongoing Professional Learning
Members recognize that a commitment to ongoing professional learning is integral to effective practice and to student learning. Professional practice and self-directed learning are informed by experience, research, collaboration and knowledge.