2009

The Ontario Curriculum
Grades 11 and 12

Technological Education

Ontario

CONTENTS

INTRODUCTION

This document replaces all but the Computer and Information Science component of *The Ontario Curriculum, Grades 11 and 12: Technological Education, 2000*. Beginning in September 2009, all technological education courses for Grades 11 and 12 will be based on the expectations outlined in this document.

SECONDARY SCHOOLS FOR THE TWENTY-FIRST CENTURY

The goal of Ontario secondary schools is to support high-quality learning while giving individual students the opportunity to choose programs that suit their skills and interests. The updated Ontario curriculum, in combination with a broader range of learning options outside traditional classroom instruction, will enable students to better customize their high school education and improve their prospects for success in school and in life.

THE IMPORTANCE OF TECHNOLOGICAL EDUCATION IN THE CURRICULUM

Technological innovation influences all areas of life, from the daily lives of individuals to the work of business and government, to interactions on a global scale. It helps meet basic human needs and provides tools for improving people's lives and exploring new frontiers. The policy outlined in this document is designed to ensure that technological education in Ontario enables students to meet the challenges and opportunities of the twenty-first century.

The power, reach, and rapid evolution of technology demand a curriculum that will enable students to become technologically literate – that is, able to understand, work with, and benefit from a range of technologies. Students need to acquire the technological skills and knowledge that will allow them to participate fully in a competitive global economy and to become responsible citizens in an environmentally vulnerable world. To succeed in today's society, students need to be effective problem solvers and critical thinkers, able to understand, question, and respond to the implications of technological innovation. Students who pursue careers in technology will also need these high-level skills to develop solutions to technological challenges or to provide the services required in their chosen fields.

Technological education focuses on developing students' ability to work creatively and competently with technologies that are central to their lives. As they proceed through their elementary and secondary school education, students attain a level of technological literacy that will enhance their ability to succeed in their postsecondary studies or in the workplace. For students who do not choose to pursue careers in technology, technological education can provide knowledge and skills that will enhance their daily lives, whether by enabling them to work on home renovations or car repairs or by allowing them to pursue technological hobbies.

Technological education promotes the integration of learning across subject disciplines. For example, when students design a product, they explore the social or human need that the product addresses (social science), the scientific principles involved in its design and construction (science), its dimensions and shape (mathematics), and the aesthetic qualities of its design (the arts). When they assess the impact that new technologies have had – or may have – on society, students are exploring historical or current events. When they consider how various technologies affect health and physical well-being, they are looking into aspects of health and physical education. Students apply business principles to the study of the production and marketing of products. They apply literacy skills to communicate design ideas, produce reports summarizing technological projects, and write instructions for the use of the products they create. Technological education also helps students develop research skills and fosters creativity, critical thinking, and problem solving. In addition, in its emphasis on innovation to meet human needs, it encourages global citizenship and promotes social, economic, and environmental awareness.

Subject matter from any course in technological education can be combined with subject matter from one or more courses in other disciplines to create an interdisciplinary course. The policies and procedures regarding the development of interdisciplinary courses are outlined in the interdisciplinary studies curriculum policy document.

The secondary school technological education curriculum is designed to build on the foundation of knowledge and skills provided by the elementary science and technology curriculum, particularly in its Understanding Structures and Mechanisms strand. In this continuum, there is a similar emphasis on foundational knowledge and skills (fundamentals), technological problem-solving skills and processes, and the relationship between technology, the environment, and society.

THE GOALS OF TECHNOLOGICAL EDUCATION

The fundamental purpose of the technological education program is to provide students with knowledge, skills, and attitudes that will enhance their ability to achieve success in secondary school, the workplace, postsecondary education or training, and daily life.

The goals of the technological education curriculum are to enable students to:

- gain an understanding of the fundamental concepts underlying technological education;
- achieve the level of technological competence they will need in order to succeed in their postsecondary education or training programs or in the workplace;
- develop a creative and flexible approach to problem solving that will help them address challenges in various areas throughout their lives;
- develop the skills, including critical thinking skills, and the knowledge of strategies required to do research, conduct inquiries, and communicate findings accurately, ethically, and effectively;
- develop lifelong learning habits that will help them adapt to technological advances in the changing workplace and world;
- make connections that will help them take advantage of potential postsecondary educational and work opportunities.

THE PHILOSOPHY OF BROAD-BASED TECHNOLOGICAL EDUCATION

The philosophy that underlies broad-based technological education is that *students learn best by doing*. This curriculum therefore adopts an activity-based, project-driven approach that involves students in problem solving as they develop knowledge and skills and gain experience in the technological subject area of their choice.

Rather than focusing on specific occupations, courses in this broad-based technology curriculum explore groups of related occupations and industry sectors within particular subject areas. So, for example, workplace preparation courses in construction technology enable students to acquire knowledge and skills related to carpentry, electrical/network cabling, heating and cooling, masonry, and plumbing.

Broad-based technology courses enable students to develop a variety of transferable skills that will serve them well in a complex and ever-changing workplace. For example, problem-solving skills are transferable skills, because they can be applied in a wide variety of situations to solve problems of various kinds. Other transferable skills emphasized in this curriculum are the "Essential Skills" and work habits identified in the Ontario Skills Passport (see pp. 33–34) as the skills and habits that enable people to perform the tasks required in their jobs and to participate fully in the workplace and the community.

FUNDAMENTAL TECHNOLOGICAL CONCEPTS

This curriculum identifies a number of fundamental concepts that inform design and production in various areas of technology. To address technological challenges and solve problems effectively, students need to take the full range of these concepts and elements of technology into account. As they progress through their technological education courses, students will come to understand these concepts more deeply, and to work with them creatively as they confront new challenges.

Fundamental Concepts	
Aesthetics	The aspects of a product, process, or service that make it pleasing to the human senses.
Control	The means by which a device or process is activated or regulated.
Environmental sustainability	The creation of products or services and use of resources in a way that allows present needs to be met without compromising the ability of future generations to meet their needs. An important related concept is that of *environmental stewardship* – the acceptance of responsibility for the sustainable use and treatment of land and other natural resources.
Ergonomics	The design of a product, process, or service in a way that takes the user's well-being with respect to its use or delivery into account – that is, in a way that minimizes discomfort, risk of injury, and expenditure of energy.
Fabrication/ building/creation	The act or process of assembling components and/or materials and resources to create a product or service.
Function	The use for which a product, process, or service is developed.

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Innovation	Original and creative thinking resulting in the effective design of a product or service.
Material	Any substance or item used in the creation of a product or delivery of a service.
Mechanism	A system of connected parts that allows a product to work or function.
Power and energy	The resource that enables a mechanism to perform work.
Safety	The care and consideration required to ensure that the product, process, or service will not cause harm.
Structure	The essential physical or conceptual parts of a product, process, or service, including the way in which the parts are constructed or organized.
Systems	The combinations of interrelated parts that make up a whole and that may be connected with other systems.

ROLES AND RESPONSIBILITIES IN TECHNOLOGICAL EDUCATION

Students

Students have many responsibilities with regard to their learning. Students who make the effort required to succeed in school and who are able to apply themselves will soon discover that there is a direct relationship between this effort and their achievement, and will therefore be more motivated to work. There will be some students, however, who will find it more difficult to take responsibility for their learning because of special challenges they face. The attention, patience, and encouragement of teachers can be extremely important to the success of these students. However, taking responsibility for their own progress and learning is an important part of education for all students, regardless of their circumstances.

Mastering the concepts and skills connected with technological education requires work, study, and the development of cooperative skills. In addition, students who actively pursue opportunities outside the classroom will extend and enrich their understanding of technology. Their understanding and skills will grow as they engage in recreational activities that involve technology (e.g., model building), reading related to technology (e.g., magazines, Internet sources), and learning about technological advances (e.g., attending technology fairs).

Parents

Parents[1] have an important role to play in supporting student learning. Studies show that students perform better in school if their parents are involved in their education. By becoming familiar with the curriculum, parents can determine what is being taught in the courses their daughters and sons are taking and what they are expected to learn. This awareness will enhance parents' ability to discuss their children's work with them, to communicate with teachers, and to ask relevant questions about their children's progress. Knowledge of the expectations in the various courses will also help parents to interpret teachers' comments on student progress and to work with teachers to improve their children's learning.

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1. The word *parents* is used in this document to refer to parent(s) and guardian(s).

Effective ways in which parents can support their children's learning include attending parent–teacher interviews, participating in parent workshops, becoming involved in school council activities (including becoming a school council member), and encouraging students to complete their assignments at home. In addition to supporting regular school activities, parents may wish to provide their daughters and sons with opportunities to question and reflect on current affairs, including news about developments in various areas of technology.

Teachers

Teachers and students have complementary responsibilities. Teachers develop appropriate instructional strategies to help students achieve the curriculum expectations, as well as appropriate methods for assessing and evaluating student learning. Teachers also support students in developing the reading, writing, oral communication, and numeracy skills needed for success in their courses. Teachers bring enthusiasm and varied teaching and assessment approaches to the classroom, addressing different student needs and ensuring sound learning opportunities for every student.

Using a variety of instructional, assessment, and evaluation strategies, teachers provide numerous hands-on opportunities for students to develop and refine their problem-solving skills, critical and creative thinking skills, and communication skills, while discovering fundamental concepts through activities and projects, exploration, and research. The activities offered should enable students to relate and apply these concepts to the social, environmental, and economic conditions and concerns of the world in which they live. Opportunities to relate knowledge and skills to these wider contexts will motivate students to learn in a meaningful way and to become lifelong learners.

Teachers need to help students understand that problem solving of any kind often requires a considerable expenditure of time and energy and a good deal of perseverance. Teachers also need to encourage students to reason, to explore alternative solutions, and to take the risks necessary to become successful problem solvers.

Teachers are also responsible for ensuring the safety of students during classroom activities and for encouraging and motivating students to assume responsibility for their own safety and the safety of others. They must also ensure that students acquire the knowledge and skills needed for safe participation in all technological activities.

Principals

The principal works in partnership with teachers and parents to ensure that each student has access to the best possible educational experience. To support student learning, principals ensure that the Ontario curriculum is being properly implemented in all classrooms using a variety of instructional approaches. They also ensure that appropriate resources are made available for teachers and students. To enhance teaching and learning in all subjects, including technological education, principals promote learning teams and work with teachers to facilitate their participation in professional development activities. Principals are also responsible for ensuring that every student who has an Individual Education Plan (IEP) is receiving the modifications and/or accommodations described in his or her plan – in other words, for ensuring that the IEP is properly developed, implemented, and monitored.

Community Partnerships

Community partners in the area of technological education can be an important resource for schools and students. They can provide support for students in the classroom, and can be models of how the knowledge and skills acquired through the study of the curriculum relate to life beyond school. As mentors, they can enrich not only the educational experience of students, but also the life of the community. Schools can, for example, make arrangements with firms or other groups in the community to provide specialists in various areas and aspects of technology (e.g., engineers, technicians, technologists, tradespeople, or experts in construction, health care services, or green industries) to participate in in-class workshops for students based on topics, concepts, and skills from the curriculum. Such firms or groups may also be interested in working with schools to create opportunities for cooperative education and apprenticeships, in connection with the Ontario Youth Apprenticeship Program (OYAP).

Schools and school boards can play a role by coordinating efforts with community partners. They can involve colleges, universities, trade unions or professional organizations, local businesses, and community volunteers in supporting instruction and in promoting a focus on technological education in and outside the school. Postsecondary institutions and other community stakeholders can be included in events held at the school (such as parent education nights, technology skills competitions, and joint ventures), and school boards can collaborate with their community partners by providing educational opportunities within the community.

THE PROGRAM IN TECHNOLOGICAL EDUCATION

OVERVIEW OF THE PROGRAM

The technological education curriculum in Grades 9–12 encompasses ten subject areas, as follows:

Communications Technology	*Health Care*
Computer Technology	*Hospitality and Tourism*
Construction Technology	*Manufacturing Technology*
Green Industries	*Technological Design*
Hairstyling and Aesthetics	*Transportation Technology*

The technological education program in Grades 11 and 12 is designed to enable students to select courses that relate to their interests and that will prepare them for further study or work in the technological field of their choice. The Grade 11 and 12 curriculum includes destination-related course types, including university/college preparation, college preparation, and workplace preparation courses, as well as open courses. The course types are defined as follows:

- *University/college preparation courses are designed to equip students with the knowledge and skills they need to meet the entrance requirement for specific programs offered at universities and colleges.*

- *College preparation courses are designed to equip students with the knowledge and skills they need to meet the requirements for entrance to most college programs or for admission to apprenticeship or other training programs.*

- *Workplace preparation courses are designed to equip students with the knowledge and skills they need to meet the expectation of employers, if they plan to enter the workforce directly after graduation, or the requirements for admission to certain apprenticeship or other training programs.*

- *Open courses are designed to broaden students' knowledge and skills in subjects that reflect their interests and prepare them for active and rewarding participation in society. They are not designed with the specific requirement of universities, colleges, or the workplace in mind.*

At least two of these course types are represented in most subject areas of the Grade 11–12 technological education curriculum (e.g., in computer technology, both university/college preparation and workplace preparation courses are provided). It should be noted that for

students planning to pursue an apprenticeship pathway, either college preparation courses or workplace preparation courses may be the appropriate choice, depending on the subject area.

In Grades 11 and 12, *destination-related* technological education courses may be delivered as courses that emphasize a particular area of the subject and/or as multiple-credit courses (see the following sections for detailed guidelines. Note that these options apply only to destination-related courses, not to open courses). The availability of these options allows school boards the flexibility to design programs that meet the specific needs of their school communities within the parameters of a standardized, rigorous curriculum for technological education for schools across the province.

Although courses in technological education are optional, students should keep in mind that they can take any Grade 9–12 technological education course to fulfil the Group 3 additional compulsory credit requirement for the Ontario Secondary School Diploma.[2] There is no restriction on the total number of technological education credits that students may earn in secondary school.

Grade 11 and 12 technological education courses are ideally suited for cooperative education programs and are often included in programs that lead to a diploma with a Specialist High Skills Major designation.

Courses in Technological Education, Grades 11 and 12*				
Grade	Course Name	Course Type	Course Code**	Prerequisite
Communications Technology				
11	Communications Technology	University/College	TGJ3M	None
11	Communications Technology: Broadcast and Print Production	Open	TGJ3O	None
12	Communications Technology	University/College	TGJ4M	Grade 11 Communications Technology, University/College
12	Communications Technology: Digital Imagery and Web Design	Open	TGJ4O	None
Computer Technology				
11	Computer Engineering Technology	University/College	TEJ3M	None
11	Computer Technology	Workplace	TEJ3E	None
12	Computer Engineering Technology	University/College	TEJ4M	Grade 11 Computer Engineering Technology, University/College
12	Computer Technology	Workplace	TEJ3E	Grade 11 Computer Technology, Workplace

* Each Grade 11 and 12 course has a credit value of 1. (Half-credit and multiple-credit courses may be developed according to conditions described in this document.)

** Course codes consist of five characters. The first three characters identify the subject; the fourth character identifies the grade (i.e., 3 and 4 refer to Grade 11 and Grade 12, respectively); and the fifth character identifies the type of course (i.e., M means "university/college preparation"; C means "college preparation"; E means "workplace preparation"; and O means "open").

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2. To meet the Group 3 additional compulsory credit requirement, students have the choice of earning one credit for a course in technological education (Grades 9 to 12) or computer studies (Grades 10 to 12), or one credit for an additional course in science (Grade 11 or 12), or one credit for a cooperative education course.

Grade	Course Name	Course Type	Course Code**	Prerequisite
Construction Technology				
11	Construction Engineering Technology	College	TCJ3C	None
11	Construction Technology	Workplace	TCJ3E	None
11	Custom Woodworking	Workplace	TWJ3E	None
12	Construction Engineering Technology	College	TCJ4C	Grade 11 Construction Engineering Technology, College
12	Construction Technology	Workplace	TCJ4E	Grade 11 Construction Technology, Workplace
12	Custom Woodworking	Workplace	TWJ4E	Grade 11 Custom Woodworking, Workplace
Green Industries				
11	Green Industries	University/College	THJ3M	None
11	Green Industries	Workplace	THJ3E	None
12	Green Industries	University/College	THJ4M	Grade 11 Green Industries, University/College
12	Green Industries	Workplace	THJ4E	Grade 11 Green Industries, Workplace
Hairstyling and Aesthetics				
11	Hairstyling and Aesthetics	Workplace	TXJ3E	None
12	Hairstyling and Aesthetics	Workplace	TXJ4E	Grade 11 Hairstyling and Aesthetics, Workplace
Health Care				
11	Health Care	University/College	TPJ3M	None
11	Health Care	College	TPJ3C	None
12	Health Care	University/College	TPJ4M	Grade 11 Health Care, University/College
12	Health Care	College	TPJ4C	Grade 11 Health Care, College
12	Child Development and Gerontology	College	TOJ4C	None
12	Health Care: Support Services	Workplace	TPJ4E	None
Hospitality and Tourism				
11	Hospitality and Tourism	College	TFJ3C	None
11	Hospitality and Tourism	Workplace	TFJ3E	None
12	Hospitality and Tourism	College	TFJ4C	Grade 11 Hospitality and Tourism, College
12	Hospitality and Tourism	Workplace	TFJ4E	Grade 11 Hospitality and Tourism, Workplace

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Courses in Technological Education, Grades 11 and 12 *(continued)*

Grade	Course Name	Course Type	Course Code**	Prerequisite
Manufacturing Technology				
11	Manufacturing Engineering Technology	University/College	TMJ3M	None
11	Manufacturing Technology	College	TMJ3C	None
11	Manufacturing Technology	Workplace	TMJ3E	None
12	Manufacturing Engineering Technology	University/College	TMJ4M	Grade 11 Manufacturing Engineering Technology, University/College
12	Manufacturing Technology	College	TMJ4C	Grade 11 Manufacturing Technology, College
12	Manufacturing Technology	Workplace	TMJ4E	Grade 11 Manufacturing Technology, Workplace
Technological Design				
11	Technological Design	University/College	TDJ3M	None
11	Technological Design and the Environment	Open	TDJ3O	None
12	Technological Design	University/College	TDJ4M	Grade 11 Technological Design, University/College
12	Technological Design in the Twenty-first Century	Open	TDJ4O	None
Transportation Technology				
11	Transportation Technology	College	TTJ3C	None
11	Transportation Technology: Vehicle Ownership	Open	TTJ3O	None
12	Transportation Technology	College	TTJ4C	Grade 11 Transportation Technology, College
12	Transportation Technology: Vehicle Maintenance	Workplace	TTJ4E	None

Prerequisite Charts for Technological Education, Grades 9–12

These charts map out all the courses in the discipline and show the links between courses and the possible prerequisites for them. They do not attempt to depict all possible movements from course to course.

Communications Technology

| Exploring Technologies / Exploring Communications Technology TIJ1O / TGJ1O *Grade 9, Open* | Communications Technology TGJ2O *Grade 10, Open* | Communications Technology TGJ3M *Grade 11, University/College* → Communications Technology TGJ4M *Grade 12, University/College* |
| | | Communications Technology: Broadcast and Print Production TGJ3O *Grade 11, Open* | Communications Technology: Digital Imagery and Web Design TGJ4O *Grade 12, Open* |

Computer Technology

| Exploring Technologies / Exploring Computer Technology TIJ1O / TEJ1O *Grade 9, Open* | Computer Technology TEJ2O *Grade 10, Open* | Computer Engineering Technology TEJ3M *Grade 11, University/College* → Computer Engineering Technology TEJ4M *Grade 12, University/College* |
| | | Computer Technology TEJ3E *Grade 11, Workplace* → Computer Technology TEJ4E *Grade 12, Workplace* |

Construction Technology

Exploring Technologies / Exploring Construction Technology TIJ1O / TCJ1O *Grade 9, Open*	Construction Technology TCJ2O *Grade 10, Open*	Construction Engineering Technology TCJ3C *Grade 11, College* → Construction Engineering Technology TCJ4C *Grade 12, College*
		Construction Technology TCJ3E *Grade 11, Workplace* → Construction Technology TCJ4E *Grade 12, Workplace*
		Custom Woodworking TWJ3E *Grade 11, Workplace* → Custom Woodworking TWJ4E *Grade 12, Workplace*

Green Industries

| Exploring Technologies / Exploring Green Industries TIJ1O / THJ1O *Grade 9, Open* | Green Industries THJ2O *Grade 10, Open* | Green Industries THJ3M *Grade 11, University/College* → Green Industries THJ4M *Grade 12, University/College* |
| | | Green Industries THJ3E *Grade 11, Workplace* → Green Industries THJ4E *Grade 12, Workplace* |

Hairstyling and Aesthetics

| Exploring Technologies / Exploring Hairstyling and Aesthetics TIJ1O / TXJ1O *Grade 9, Open* | Hairstyling and Aesthetics TXJ2O *Grade 10, Open* | Hairstyling and Aesthetics TXJ3E *Grade 11, Workplace* → Hairstyling and Aesthetics TXJ4E *Grade 12, Workplace* |

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Prerequisite Charts for Technological Education, Grades 9–12 *(continued)*

Health Care

Exploring Technologies / Exploring Health Care TIJ1O / TPJ1O *Grade 9, Open*	Health Care TPJ2O *Grade 10, Open*	Health Care TPJ3M *Grade 11, University/College* →	Health Care TPJ4M *Grade 12, University/College*
		Health Care TPJ3C *Grade 11, College* →	Health Care TPJ4C *Grade 12, College*
			Child Development and Gerontology TOJ4C *Grade 12, College*
			Health Care: Support Services TPJ4E *Grade 12, Workplace*

Hospitality and Tourism

| Exploring Technologies / Exploring Hospitality and Tourism
TIJ1O / TFJ1O
Grade 9, Open | Hospitality and Tourism
TFJ2O
Grade 10, Open | Hospitality and Tourism
TFJ3C
Grade 11, College → | Hospitality and Tourism
TFJ4C
Grade 12, College |
| | | Hospitality and Tourism
TFJ3E
Grade 11, Workplace → | Hospitality and Tourism
TFJ4E
Grade 12, Workplace |

Manufacturing Technology

Exploring Technologies / Exploring Manufacturing Technology TIJ1O / TMJ1O *Grade 9, Open*	Manufacturing Technology TMJ2O *Grade 10, Open*	Manufacturing Engineering Technology TMJ3M *Grade 11, University/College* →	Manufacturing Engineering Technology TMJ4M *Grade 12, University/College*
		Manufacturing Technology TMJ3C *Grade 11, College* →	Manufacturing Technology TMJ4C *Grade 12, College*
		Manufacturing Technology TMJ3E *Grade 11, Workplace* →	Manufacturing Technology TMJ4E *Grade 12, Workplace*

Technological Design

| Exploring Technologies / Exploring Technological Design
TIJ1O / TDJ1O
Grade 9, Open | Technological Design
TDJ2O
Grade 10, Open | Technological Design
TDJ3M
Grade 11, University/College → | Technological Design
TDJ4M
Grade 12, University/College |
| | | Technological Design and the Environment
TDJ3O
Grade 11, Open | Technological Design in the Twenty-first Century
TDJ4O
Grade 12, Open |

Transportation Technology

| Exploring Technologies / Exploring Transportation Technology
TIJ1O / TTJ1O
Grade 9, Open | Transportation Technology
TTJ2O
Grade 10, Open | Transportation Technology
TTJ3C
Grade 11, College → | Transportation Technology
TTJ4C
Grade 12, College |
| | | Transportation Technology: Vehicle Ownership
TTJ3O
Grade 11, Open | Transportation Technology: Vehicle Maintenance
TTJ4E
Grade 12, Workplace |

Options for Course Delivery in Grades 11 and 12

Emphasis Courses

In Grades 11 and 12, a destination-related[3] broad-based technology course may be developed to emphasize a particular area of the subject (that is, an area related to a particular sector or particular occupations connected with the subject). For example, a workplace preparation course in computer technology could emphasize computer repair, or a university/college preparation course in technological design could be developed to emphasize apparel and textile design. However, an emphasis course must not entirely exclude other areas of the subject that relate to different sectors or occupations.

The topics and applications that must be addressed in an emphasis course are evident from the course description and the expectations and examples provided for the broad-based course outlined in this document. For example, it is expected that students taking a one-credit (110-hour) Grade 11 university/college preparation course in green industries with an emphasis on forestry will nevertheless explore all areas of the green industries, including agribusiness, horticulture management and science, and landscaping architecture,[4] and that the course will be delivered according to the philosophy of broad-based technological education outlined in this document (see p. 7). (Teachers will notice that the examples that accompany many of the specific expectations in courses outlined in this document are designed to illustrate the expectation from the perspective of several possible emphasis areas.)

Regardless of the area emphasized in a course, students must be given the opportunity to achieve all of the expectations of the course outlined in this document.

The emphasis courses that may be developed in each technological education subject can be identified, along with the course codes that must be assigned to them, from the list of Common Course Codes on the Ministry of Education's website (at www.edu.gov.on.ca). In school calendars, the course description for the emphasis course may be created by adding an additional sentence to the course description provided in this document.

A student may take, and earn credit for the successful completion of, more than one course in any given technological education subject in Grade 11 and/or Grade 12. For example, a student may take two Grade 11 university/college preparation health care courses, one emphasizing dental services and another focusing on pharmacy services (these emphasis areas are specified on the ministry website). Similarly, a student might take the regular broad-based Grade 12 workplace preparation course in hospitality and tourism (as outlined in this document), as well as another Grade 12 hospitality and tourism workplace preparation course, developed on the basis of the same set of expectations but emphasizing baking.

Multiple-Credit Courses

A destination-related[5] broad-based technology course in Grade 11 or 12 may be planned for up to 330 hours of scheduled instructional time (for which the student may earn a maximum of three credits) if the course is part of a Specialist High Skills Major program or school–work transition program, if it leads to an apprenticeship or certification program, or if it supports an articulation agreement for advanced standing or preferred

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3. In Grades 11 and 12, open courses may not be offered as emphasis courses.

4. If the course is developed as a multiple-credit course, the first 110 hours of the course must be delivered in this way, addressing all areas within the subject. The remaining instructional time may be dedicated to the specified area of emphasis.

5. In Grades 11 and 12, open courses may not be offered as multiple-credit courses.

entrance into a specialized program. The additional instructional time allows for the practice and refinement of skills needed to raise the quality of the student's performance to the level required for entry into a subsequent program or the workplace. The skills students develop in multiple-credit courses should reflect current industry practices and standards.

Instructional time may be increased by increments of 55 hours. For each additional 55 hours, students earn an additional half-credit, to a maximum of three credits. The number of additional credits and the nature of the knowledge and skills to be practised and refined during the additional instructional time must be established before the start of the course.

Any destination-related course, including emphasis courses, may be delivered as a multiple-credit course.

Half-Credit Courses

The courses outlined in the technological education curriculum documents are designed as full-credit courses. However, *with the exception of the Grade 12 university/college preparation courses*, they may also be delivered as half-credit courses.

Half-credit courses, which require a minimum of fifty-five hours of scheduled instructional time, must adhere to the following conditions:

- The two half-credit courses created from a full course must together contain all of the expectations of the full course. The expectations for each half-credit course must be drawn from all strands of the full course and must be divided in a manner that best enables students to achieve the required knowledge and skills in the allotted time.

- A course that is a prerequisite for another course in the secondary curriculum may be offered as two half-credit courses, but students must successfully complete both parts of the course to fulfil the prerequisite. (Students are not required to complete both parts unless the course is a prerequisite for another course they wish to take.)

- The title of each half-credit course must include the designation *Part 1* or *Part 2*. A half credit (0.5) will be recorded in the credit-value column of both the report card and the Ontario Student Transcript.

Boards will ensure that all half-credit courses comply with the conditions described above, and will report all half-credit courses to the ministry annually in the School October Report.

CURRICULUM EXPECTATIONS

The expectations identified for each course describe the knowledge and skills that students are expected to develop and demonstrate in their class work, on tests, and in various other activities on which their achievement is assessed and evaluated.

Two sets of expectations are listed for each strand, or broad curriculum area, of each course. (The strands are numbered A, B, C, D, and, in some courses, E.)

- The *overall expectations* describe in general terms the knowledge and skills that students are expected to demonstrate by the end of each course.

- The *specific expectations* describe the expected knowledge and skills in greater detail. The specific expectations are grouped under numbered subheadings, each of which indicates the strand and the overall expectation to which the subgrouping of

specific expectations corresponds (e.g., "B2" indicates that the group relates to overall expectation 2 in strand B). The subheadings may serve as a guide for teachers as they plan learning activities for their students.

The organization of expectations into strands and subgroupings is not meant to imply that the expectations in any one strand or group are achieved independently of the expectations in the other strands or groups. The strands and subgroupings are used merely to help teachers focus on particular aspects of knowledge and skills as they develop various learning activities for their students. The concepts, content, and skills identified in the different strands of each course should, wherever appropriate, be integrated in instruction throughout the course.

Many of the specific expectations are accompanied by examples, which are given in parentheses and italicized. These examples are meant to illustrate the kind of knowledge or skill, the specific area of learning, the depth of learning, and/or the level of complexity that the expectation entails. In addition, the examples provided within a broad-based technological education course may collectively reflect the range of areas represented within a given subject (e.g., a construction technology course may include examples that are applicable to plumbing, electrical/network cabling, masonry, heating and cooling, and carpentry).

The examples are intended as a guide for teachers rather than as an exhaustive or mandatory list. Teachers can choose to use the examples that are appropriate for their classrooms or they may develop their own approaches that reflect a similar level of complexity. Whatever the specific ways in which the requirements outlined in the expectations are implemented in the classroom, they must, wherever possible, be inclusive and reflect the diversity of the student population and the population of the province.

STRANDS IN THE TECHNOLOGICAL EDUCATION CURRICULUM

The overall and specific expectations for each course in the technological education curriculum are typically organized in four distinct but related strands. As students move up through the grades, the expectations within these strands will increase in complexity and depth. These strands are as follows:

Fundamentals: Students develop foundational knowledge and skills related to the design and fabrication of products or the provision of services in the particular broad-based technological subject area.

Skills: Students develop the technological skills required for responding to a variety of practical challenges.

Technology, the Environment, and Society: Students develop an understanding of the interrelationship between the technology or industry sector and the environment, and between the technology and various aspects of society. (In subject areas that relate to services, this strand is entitled Industry Practices, the Environment, and Society.)

Professional Practice and Career Opportunities: Students develop an understanding of health and safety standards in the industry, professional concerns and issues, and the Essential Skills and work habits valued in the sector, and explore career opportunities and the education and training required for them.

Technological education courses are typically organized into four **strands**, numbered A, B, C, and D.

The **overall expectations** describe in general terms the knowledge and skills students are expected to demonstrate by the end of each course. Two or more overall expectations are provided for each strand in every course. The numbering of overall expectations indicates the strand to which they belong (e.g., B1–B4 are the overall expectations for strand B).

A **numbered subheading** identifies each group of specific expectations and relates to one particular overall expectation (e.g., "B1. Design and Planning Process" relates to overall expectation B1).

The **specific expectations** describe the expected knowledge and skills in greater detail. The expectation number identifies the strand to which the expectation belongs and the overall expectation to which it relates (e.g., B1.1, B1.2, B1.3, and so on, relate to the first overall expectation in strand B).

The **examples** help to clarify the requirement specified in the expectation and to suggest its intended depth and level of complexity. The examples are illustrations only, not requirements. They appear in parentheses and are set in italics.

B. MANUFACTURING TECHNOLOGY SKILLS

Manufacturing Engineering Technology

TMJ4M

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. apply a design process to plan and develop solutions, products, or services in response to challenges in manufacturing technology;

B2. demonstrate an understanding of the management of a manufacturing enterprise and the interrelationships among its major areas of activity such as marketing, cost control, quality assurance, production, and inventory control;

B3. demonstrate the safe and effective use of tools, equipment, and materials in the production of a product or the development of a production process;

B4. develop and use a quality assurance system to industry standards in the production of a project.

SPECIFIC EXPECTATIONS

B1. Design and Planning Process

By the end of this course, students will:

B1.1 use reverse engineering to explain existing products or processes in terms of function;

B1.2 demonstrate proficiency in using a design process to plan and develop solutions to manufacturing-related challenges;

B1.3 create a working drawing (*e.g., orthographic, isometric, pictorial*) with the use of computer-aided design that includes appropriate information (*e.g., geometric dimensioning and tolerancing, section views, symbols and abbreviations*) to assist in the development of solutions to manufacturing challenges;

B1.4 use a variety of communication techniques (*e.g., multimedia presentation, electronic presentation*) and supporting documentation (*e.g., prints, technical reports, statistical charting*) to present and explain a process design and plan;

B1.5 generate product specifications through the accurate interpretation of engineering drawings, sketches, and reports;

B1.6 select suitable materials for fabricating products based on the design specifications and the intended use of the products;

B1.7 use a design and planning process to solve a manufacturing challenge (*e.g., design and build a robot or control system prototype; design an auto-* mated manufacturing system using process control charts; design solutions to create an ergonomically effective work environment*).

B2. Project Management

By the end of this course, students will:

B2.1 demonstrate an understanding of management roles in the development of a product (*e.g., planning: setting goals to establish course of action; organizing: structuring the job into manageable tasks; directing: assigning tasks and supervising their completion; controlling: comparing results against the original plan*);

B2.2 demonstrate an understanding of the management of a manufacturing enterprise (*e.g., set up and manage, in collaboration with others, a small-scale manufacturing enterprise; visit and document the activities of a local manufacturing enterprise*) and its major areas of activity (*e.g., research and development, production, marketing, and finance*);

B2.3 create, in collaboration with others, a detailed process plan (*e.g., including robotic applications and other tools, machines, and equipment required*) to fabricate a final product;

B2.4 create, in collaboration with others, a product or process prototype/model (*e.g., rapid prototyping process*);

MANUFACTURING TECHNOLOGY SKILLS

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PROBLEM SOLVING IN TECHNOLOGICAL EDUCATION

An approach to learning that emphasizes problem solving is the best way to prepare students for the challenges they will face in the world beyond school. In the workplace, projects or tasks may not always be clearly defined or have prescribed solutions. Students who have a strong background in problem solving will be more confident and better equipped to address new challenges in a variety of contexts.

Learning through problem solving will help students appreciate that all challenges – whether large or small, complex or simple – are most effectively resolved when approached systematically, using a simple method or a more comprehensive process, depending on the nature of the problem.

The range of challenges students encounter in technological education is wide and varied. At one end are simple problems for which there is likely to be only one solution – for example, substituting a part to fix an obvious fault. At the other end are complex challenges – for example, devising a solution to an identified human need – for which there could be various different solutions and which call for a detailed process that may involve consultations with stakeholders to clearly define the problem and determine criteria for its solution, and the design and testing of several potential solutions. In many cases, the nature of the problem, and the problem-solving process required to solve it, fall somewhere between these two extremes.

Technological education teachers can guide students through problem solving by helping them understand the nature and scope of a problem and the type of approach or method best suited to address it. They can also remind students that there is often more than one solution, give them the freedom to explore ideas, and encourage them to retrace steps and persist in their efforts when they encounter obstacles.

Problem-Solving Methods and Approaches

Problem-solving processes share at least some of a number of systematic steps – for example, identifying the problem, analysing the situation, considering possible solutions, selecting the best solution, testing and evaluating the effectiveness of the solution, and reviewing or repeating steps as necessary to improve the solution. Among the various problem-solving methods and approaches that may be employed to address the range of problems students will encounter in technological education are those listed below. This list is not comprehensive, and may be supplemented by various other methods in the classroom.

Parts Substitution

Perhaps the most basic of all the problem-solving methods, "parts substitution" simply requires that parts be substituted until the problem is solved. Although it is not the most scientific method of problem solving, there may be no other alternative if tests do not indicate what could be causing the problem.

Diagnostics

An example of a diagnostic problem-solving method is troubleshooting an engine fault in an automobile. After identifying the general problem, the technician would run tests to pinpoint the fault. The test results would be used either as a guide for further testing or for replacement of a part, which would also need to be tested. This process continues until the solution is found and the car is running properly.

Reverse Engineering

Reverse engineering is the process of discovering the technological principles underlying the design of a device by taking the device apart, or carefully tracing its workings or its circuitry. It is useful when students are attempting to build something for which they have no formal drawings or schematics.

Divide and Conquer

"Divide and conquer" is the technique of breaking down a problem into subproblems, then breaking the subproblems down even further until each of them is simple enough to be solved. Divide and conquer may be applied to allow groups of students to tackle sub-problems of a larger problem, or when a problem is so large that its solution cannot be visualized without breaking it down into smaller components.

Extreme Cases

Considering "extreme cases" – envisioning the problem in a greatly exaggerated or greatly simplified form, or testing using an extreme condition – can often help to pinpoint a problem. An example of the extreme-case method is purposely inputting an extremely high number to test a computer program.
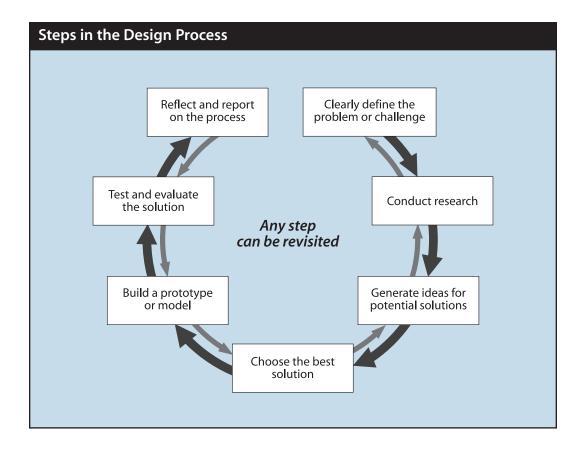
Trial and Error

The trial-and-error method involves trying different approaches until a solution is found. It is often used as a last resort when other methods have been exhausted.

The Design Process

In many technological fields, open-ended problem-solving processes that involve the full planning and development of products or services to meet identified needs are often referred to as the "design process". A design process involves a sequence of steps, such as the following:

- Analyse the context and background, and clearly define the problem or challenge.
- Conduct research to determine design criteria, financial or other constraints, and availability of materials.
- Generate ideas for potential solutions, using processes such as brainstorming and sketching.
- Choose the best solution.
- Build a prototype or model.
- Test and evaluate the solution.
- Repeat steps as necessary to modify the design or correct faults.
- Reflect and report on the process.

Steps in the Design Process

Reflect and report on the process

Clearly define the problem or challenge

Test and evaluate the solution

Conduct research

Any step can be revisited

Build a prototype or model

Generate ideas for potential solutions

Choose the best solution

Although processes such as this involve a framework of sequential steps, they are typically iterative processes that may require a retracing of steps, diversions to solve specific problems along the way, or even a return to the start of the process if it becomes clear that the situation needs to be clarified and the problem redefined. Problem solvers soon discover that the process calls for an open mind, the freedom to be creative, and a great deal of patience and persistence.

ASSESSMENT AND EVALUATION OF STUDENT ACHIEVEMENT

BASIC CONSIDERATIONS

The primary purpose of assessment and evaluation is to improve student learning. Information gathered through assessment helps teachers to determine students' strengths and weaknesses in their achievement of the curriculum expectations in each course. This information also serves to guide teachers in adapting curriculum and instructional approaches to students' needs and in assessing the overall effectiveness of programs and classroom practices.

Assessment is the process of gathering information from a variety of sources (including assignments, day-to-day observations, conversations or conferences, demonstrations, projects, performances, and tests) that accurately reflects how well a student is achieving the curriculum expectations in a course. As part of assessment, teachers provide students with descriptive feedback that guides their efforts towards improvement. Evaluation refers to the process of judging the quality of student work on the basis of established criteria, and assigning a value to represent that quality.

Assessment and evaluation will be based on the provincial curriculum expectations and the achievement levels outlined in this document.

In order to ensure that assessment and evaluation are valid and reliable, and that they lead to the improvement of student learning, teachers must use assessment and evaluation strategies that:

- address both what students learn and how well they learn;
- are based both on the categories of knowledge and skills and on the achievement level descriptions given in the achievement chart on pages 28–29;
- are varied in nature, administered over a period of time, and designed to provide opportunities for students to demonstrate the full range of their learning;
- are appropriate for the learning activities used, the purposes of instruction, and the needs and experiences of the students;

- are fair to all students;

- accommodate the needs of students with special education needs, consistent with the strategies outlined in their Individual Education Plan;

- accommodate the needs of students who are learning the language of instruction (English or French);

- ensure that each student is given clear directions for improvement;

- promote students' ability to assess their own learning and to set specific goals;

- include the use of samples of students' work that provide evidence of their achievement;

- are communicated clearly to students and parents at the beginning of the course or the school term and at other appropriate points throughout the school year.

Evaluation of Achievement of Overall Expectations

All curriculum expectations must be accounted for in instruction, but evaluation focuses on students' achievement of the overall expectations. A student's achievement of the overall expectations is evaluated on the basis of his or her achievement of related specific expectations. The overall expectations are broad in nature, and the specific expectations define the particular content or scope of the knowledge and skills referred to in the overall expectations. Teachers will use their professional judgement to determine which specific expectations should be used to evaluate achievement of the overall expectations, and which ones will be covered in instruction and assessment (e.g., through direct observation) but not necessarily evaluated.

Levels of Achievement

The characteristics given in the achievement chart (pp. 28–29) for level 3 represent the "provincial standard" for achievement of the expectations in a course. A complete picture of overall achievement at level 3 in a course in technological education can be constructed by reading from top to bottom in the shaded column of the achievement chart, headed "70–79% (Level 3)". Parents of students achieving at level 3 can be confident that their children will be prepared for work in subsequent courses.

Level 1 identifies achievement that falls much below the provincial standard, while still reflecting a passing grade. Level 2 identifies achievement that approaches the standard. Level 4 identifies achievement that surpasses the standard. It should be noted that achievement at level 4 does not mean that the student has achieved expectations beyond those specified for a particular course. It indicates that the student has achieved all or almost all of the expectations for that course, and that he or she demonstrates the ability to use the specified knowledge and skills in more sophisticated ways than a student achieving at level 3.

THE ACHIEVEMENT CHART FOR TECHNOLOGICAL EDUCATION

The achievement chart that follows identifies four categories of knowledge and skills in technological education. The achievement chart is a standard province-wide guide to be used by teachers. It enables teachers to make judgements about student work that are based on clear performance standards and on a body of evidence collected over time.

The purpose of the achievement chart is to:

- provide a common framework that encompasses all curriculum expectations for all courses outlined in this document;
- guide the development of high-quality assessment tasks and tools (including rubrics);
- help teachers to plan instruction for learning;
- assist teachers in providing meaningful feedback to students;
- provide various categories and criteria with which to assess and evaluate students' learning.

Categories of Knowledge and Skills

The categories, defined by clear criteria, represent four broad areas of knowledge and skills within which the subject expectations for any given course are organized. The four categories should be considered as interrelated, reflecting the wholeness and interconnectedness of learning.

The categories of knowledge and skills are described as follows:

Knowledge and Understanding. Subject-specific content acquired in each course (knowledge), and the comprehension of its meaning and significance (understanding).

Thinking. The use of critical and creative thinking skills and/or processes, as follows:

- planning skills (e.g., identifying the problem, selecting strategies and resources, scheduling)
- processing skills (e.g., analysing and interpreting information, reasoning, generating and evaluating solutions, forming conclusions)
- critical/creative thinking processes (e.g., problem-solving, design, and decision-making processes)

Communication. The conveying of meaning through various forms, as follows:

- oral (e.g., role play, discussion, presentation)
- written (e.g., design briefs, work orders, technical reports)
- visual (e.g., technical drawings, flow charts, graphics)

Application. The use of knowledge and skills to make connections within and between various contexts.

Teachers will ensure that student work is assessed and/or evaluated in a balanced manner with respect to the four categories, and that achievement of particular expectations is considered within the appropriate categories.

Criteria

Within each category in the achievement chart, criteria are provided that are subsets of the knowledge and skills that define each category. For example, in Knowledge and Understanding, the criteria are "knowledge of content (e.g., facts, equipment, terminology, materials)" and "understanding of content (e.g., procedures, technological concepts, processes, industry standards)". The criteria identify the aspects of student performance that are assessed and/or evaluated, and serve as guides to what to look for.

Descriptors

A "descriptor" indicates the characteristic of the student's performance, with respect to a particular criterion, on which assessment or evaluation is focused. In the achievement chart, *effectiveness* is the descriptor used for each criterion in the Thinking, Communication, and Application categories. What constitutes effectiveness in any given performance task will vary with the particular criterion being considered. Assessment of effectiveness may therefore focus on a quality such as appropriateness, clarity, accuracy, precision, logic, relevance, significance, fluency, flexibility, depth, or breadth, as appropriate for the particular criterion. For example, in the Thinking category, assessment of effectiveness might focus on the degree of relevance or depth apparent in an analysis; in the Communication category, on clarity of expression or logical organization of information and ideas; or in the Application category, on appropriateness or breadth in the making of connections. Similarly, in the Knowledge and Understanding category, assessment of knowledge might focus on accuracy, and assessment of understanding might focus on the depth of an explanation. Descriptors help teachers to focus their assessment and evaluation on specific knowledge and skills for each category and criterion, and help students to better understand exactly what is being assessed and evaluated.

Qualifiers

A specific "qualifier" is used to define each of the four levels of achievement – that is, *limited* for level 1, *some* for level 2, *considerable* for level 3, and a *high degree* or *thorough* for level 4. A qualifier is used along with a descriptor to produce a description of performance at a particular level. For example, the description of a student's performance at level 3 with respect to the first criterion in the Thinking category would be: "the student uses planning skills with *considerable* effectiveness".

The descriptions of the levels of achievement given in the chart should be used to identify the level at which the student has achieved the expectations. In all of their courses, students should be given numerous and varied opportunities to demonstrate the full extent of their achievement of the curriculum expectations across all four categories of knowledge and skills.

ACHIEVEMENT CHART: TECHNOLOGICAL EDUCATION, GRADES 9–12

Categories	50–59% (Level 1)	60–69% (Level 2)	70–79% (Level 3)	80–100% (Level 4)
Knowledge and Understanding – Subject-specific content acquired in each course (knowledge), and the comprehension of its meaning and significance (understanding)				
	The student:			
Knowledge of content *(e.g., facts, equipment, termi-nology, materials)*	demonstrates limited knowl-edge of content	demonstrates some knowledge of content	demonstrates considerable knowledge of content	demonstrates thorough knowl-edge of content
Understanding of content *(e.g., procedures, technological concepts, processes, industry standards)*	demonstrates limited under-standing of content	demonstrates some under-standing of content	demonstrates considerable understanding of content	demonstrates thorough under-standing of content
Thinking – The use of critical and creative thinking skills and/or processes				
	The student:			
Use of planning skills *(e.g., identifying the problem, selecting strategies and resources, scheduling)*	uses planning skills with limited effectiveness	uses planning skills with some effectiveness	uses planning skills with considerable effectiveness	uses planning skills with a high degree of effectiveness
Use of processing skills *(e.g., analysing and interpret-ing information, reasoning, generating and evaluating solutions, forming conclu-sions)*	uses processing skills with limited effectiveness	uses processing skills with some effectiveness	uses processing skills with considerable effectiveness	uses processing skills with a high degree of effectiveness
Use of critical/creative thinking processes *(e.g., problem-solving, design, and decision-making processes)*	uses critical/creative thinking processes with limited effectiveness	uses critical/creative thinking processes with some effectiveness	uses critical/creative thinking processes with considerable effectiveness	uses critical/creative thinking processes with a high degree of effectiveness

Categories	50–59% (Level 1)	60–69% (Level 2)	70–79% (Level 3)	80–100% (Level 4)
Communication – The conveying of meaning through various forms				
	The student:			
Expression and organization of ideas and information *(e.g., clear expression, logical organization)* **in oral, visual, and written forms**	expresses and organizes ideas and information with limited effectiveness	expresses and organizes ideas and information with some effectiveness	expresses and organizes ideas and information with considerable effectiveness	expresses and organizes ideas and information with a high degree of effectiveness
Communication for different audiences in oral, visual, and written forms	communicates for different audiences and purposes with limited effectiveness	communicates for different audiences and purposes with some effectiveness	communicates for different audiences and purposes with considerable effectiveness	communicates for different audiences and purposes with a high degree of effectiveness
Use of conventions *(e.g., standards/symbols, units of measurement, acronyms)*, **vocabulary, and terminology of the discipline in oral, visual, and written forms**	uses conventions, vocabulary, and terminology of the discipline with limited effectiveness	uses conventions, vocabulary, and terminology of the discipline with some effectiveness	uses conventions, vocabulary, and terminology of the discipline with considerable effectiveness	uses conventions, vocabulary, and terminology of the discipline with a high degree of effectiveness
Application – The use of knowledge and skills to make connections within and between various contexts				
	The student:			
Application of knowledge and skills *(e.g., concepts, processes, use of equipment and technology)* **in familiar contexts**	applies knowledge and skills in familiar contexts with limited effectiveness	applies knowledge and skills in familiar contexts with some effectiveness	applies knowledge and skills in familiar contexts with considerable effectiveness	applies knowledge and skills in familiar contexts with a high degree of effectiveness
Transfer of knowledge and skills *(e.g., concepts, processes, use of equipment and technology)* **to new contexts**	transfers knowledge and skills to new contexts with limited effectiveness	transfers knowledge and skills to new contexts with some effectiveness	transfers knowledge and skills to new contexts with considerable effectiveness	transfers knowledge and skills to new contexts with a high degree of effectiveness
Making connections within and between various contexts *(e.g., between disciplines; between technology, the environment, and society; between school and future opportunities)*	makes connections within and between various contexts with limited effectiveness	makes connections within and between various contexts with some effectiveness	makes connections within and between various contexts with considerable effectiveness	makes connections within and between various contexts with a high degree of effectiveness

Note: A student whose achievement is below 50% at the end of a course will not obtain a credit for the course.

EVALUATION AND REPORTING OF STUDENT ACHIEVEMENT

Student achievement must be communicated formally to students and parents by means of the Provincial Report Card, Grades 9–12. The report card provides a record of the student's achievement of the curriculum expectations in every course, at particular points in the school year or semester, in the form of a percentage grade. The percentage grade represents the quality of the student's overall achievement of the expectations for the course and reflects the corresponding level of achievement as described in the achievement chart for the discipline.

A final grade is recorded for every course, and a credit is granted and recorded for every course in which the student's grade is 50% or higher. The final grade for each course in Grades 9 to 12 will be determined as follows:

- Seventy per cent of the grade will be based on evaluations conducted throughout the course. This portion of the grade should reflect the student's most consistent level of achievement throughout the course, although special consideration should be given to more recent evidence of achievement.
- Thirty per cent of the grade will be based on a final evaluation in the form of an examination, performance, essay, and/or other method of evaluation suitable to the course content and administered towards the end of the course.

REPORTING ON DEMONSTRATED LEARNING SKILLS

The report card provides a record of the learning skills demonstrated by the student in every course, in the following five categories: Works Independently, Teamwork, Organization, Work Habits, and Initiative. The learning skills are evaluated using a four-point scale (E–Excellent, G–Good, S–Satisfactory, N–Needs Improvement). The separate evaluation and reporting of the learning skills in these five areas reflect their critical role in students' achievement of the curriculum expectations. To the extent possible, the evaluation of learning skills, apart from any that may be included as part of a curriculum expectation in a course, should not be considered in the determination of percentage grades.

SOME CONSIDERATIONS FOR PROGRAM PLANNING

Teachers who are planning a program in technological education must take into account considerations in a number of important areas, including those discussed below.

INSTRUCTIONAL APPROACHES

Technological education involves knowing and doing, and teaching and learning approaches should address both areas. Teachers should use projects as a major means of achieving course expectations, and students should be provided with a combination of information and experiences that will prepare them to make informed choices about the use of various technologies, to use technology wisely and well, and to solve technological problems.

Students learn best when they are engaged in learning in a variety of ways. Technological education courses lend themselves to a wide range of approaches in that they require students to discuss issues, solve problems, plan solutions, participate in development of solutions, conduct research, think critically, and work cooperatively. When students are engaged in active and experiential learning strategies, they tend to retain knowledge for longer periods and to develop, acquire, and integrate key skills more completely.

Programs in technological education should involve an open, collaborative, activity-based approach to teaching that accommodates students' interests, aspirations, and learning styles. Activities should be designed to include both individual and team approaches, as technological projects in the workplace often require individuals to work collaboratively while undertaking a variety of roles and tasks. Students should be given opportunities to work both independently and with teacher direction, and to learn through the study of examples followed by practice. There is no single correct way to teach or to learn, and the strategies used in the classroom should vary according to the curriculum expectations and the needs of the students. Problem solving and/or the design process should be an integral part of all broad-based technological education. Teachers should work collaboratively with colleagues to plan and deliver the technological education curriculum. Individual teachers can contribute their expertise in particular areas of technology to ensure the successful implementation of the curriculum.

Some of the teaching and learning strategies that are suitable to material taught in technological education employ scaffolding. Scaffolding is an instructional approach that involves breaking down tasks so that students can concentrate on specific, manageable objectives and gradually build understanding and skill, with the aid of modelling by the teacher and ample opportunity for practice. Scaffolding provides students with a supportive structure within which to learn.

Some of the concepts taught in technological education involve abstract thinking, which can be difficult for many students. Role playing is an approach teachers can employ to help students internalize new concepts. Learning processes that include opportunities for physical activity by students can lead to better understanding and longer retention of concepts. The use of kinesthetic learning can be an effective way to adapt technological education to the varied learning styles that students may demonstrate.

When students work collaboratively they often accomplish more than when they work individually. Group activities, when used in a structured way, can enhance learning and foster positive attitudes. When working in a team, each student should have a specific role and be actively involved in the task. It is important to give students opportunities to take on different roles, from one project to another or in the course of a large project.

Students' attitudes towards technological education can have a significant effect on their achievement of expectations. Teaching methods and learning activities that encourage students to recognize the value and relevance of what they are learning for work and their lives beyond school will go a long way towards motivating students to work and learn effectively.

The study of current events related to technologies in various industries, including emerging technologies, should inform the technological education curriculum, enhancing both the relevance and the immediacy of the program. Discussion of current events related to various technologies and inclusion of these topics in daily lessons will stimulate students' interest and curiosity and also help them connect what they are learning in class with real-world events or situations. The study of events in industry sectors and technological developments in the world needs to be thought of not as a separate topic removed from the program but as an effective instructional strategy for implementing many of the expectations found in the curriculum.

HEALTH AND SAFETY IN TECHNOLOGICAL EDUCATION

Health and safety is of paramount importance in technological education. In every course, students must be made aware that health and safety is everyone's responsibility – at home, at school, and in the workplace. Before using any piece of equipment or any tool, students must be able to demonstrate knowledge of how the equipment or tool works and of the procedures they must follow to ensure its safe use. Personal protective gear must be worn as required.

Classroom practice and all aspects of the learning environment must comply with relevant municipal, provincial, or federal health and safety legislation, including the following:

- the Ontario Workplace Safety and Insurance Act
- the Workplace Hazardous Materials Information System (WHMIS)
- the Food and Drugs Act
- the Ontario Health Protection and Promotion Act
- the Ontario Building Code
- the Occupational Health and Safety Act
- local by-laws

Teachers should make use of all available and relevant resources to make students sufficiently aware of the importance of health and safety. These resources include:

- Live Safe! Work Smart! – website and related resources
- Passport to Safety – website and related resources
- Workplace Safety and Insurance Board (WSIB)
- Industrial Accident Prevention Association (IAPA)
- Ontario Ministry of Labour (MOL)
- Canadian Centre for Occupational Health and Safety (CCOHS)
- appropriate Safe Workplace Associations (SWAs) and clinics, such as the Construction Safety Association of Ontario (CSAO), the Ontario Service Safety Alliance (OSSA), the Transportation Health and Safety Association of Ontario (THSAO), the Electrical & Utilities Safety Association (E&USA), the Workers Health & Safety Centre (WHSC), and the Occupational Health Clinics for Ontario Workers (OHCOW)

Teachers are responsible for ensuring the safety of students during technology lab, shop, and classroom activities. Health and safety issues must also be addressed when learning involves cooperative education and other workplace experiences (see p. 43). Teachers need to encourage and motivate students to assume responsibility for their own safety and the safety of others, and they must help students develop the knowledge and skills needed for safe participation in all technology-related activities. For these reasons, teachers must model safe practices at all times and communicate safety expectations to students in accordance with school board policies and procedures, Ministry of Education policies, and Ministry of Labour regulations.

THE ONTARIO SKILLS PASSPORT AND ESSENTIAL SKILLS

Teachers planning programs in technological education need to be aware of the purpose and benefits of the Ontario Skills Passport (OSP). The OSP is a bilingual web-based resource that enhances the relevance of classroom learning for students and strengthens school–work connections. The OSP provides clear descriptions of Essential Skills such as Reading Text, Writing, Computer Use, Measurement and Calculation, and Problem Solving and includes an extensive database of occupation-specific workplace tasks that illustrate how workers use these skills on the job. The Essential Skills are transferable, in

SOME CONSIDERATIONS FOR PROGRAM PLANNING

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that they are used in virtually all occupations. The OSP also includes descriptions of important work habits, such as working safely, being reliable, and providing excellent customer service. The OSP is designed to help employers assess and record students' demonstration of these skills and work habits during their cooperative education placements. Students can use the OSP to assess, practise, and build their Essential Skills and work habits and transfer them to a job or further education or training.

The skills described in the OSP are the Essential Skills that the Government of Canada and other national and international agencies have identified and validated, through extensive research, as the skills needed for work, learning, and life. These Essential Skills provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change. For further information on the OSP and the Essential Skills, visit http://skills.edu.gov.on.ca.

THE ROLE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY IN TECHNOLOGICAL EDUCATION

Information and communications technologies (ICT) provide a range of tools that can significantly extend and enrich teachers' instructional strategies and support student learning. ICT tools include multimedia resources, databases, Internet websites, digital cameras, and word-processing programs. Tools such as these can help students to collect, organize, and sort the data they gather and to write, edit, and present reports on their findings. Information and communications technologies can also be used to connect students to other schools, at home and abroad, and to bring the global community into the local classroom.

Whenever appropriate, therefore, students should be encouraged to use ICT to support and communicate their learning. For example, students working individually or in groups can use computer technology and/or Internet websites to gain access to technical information in Canada and around the world. Students can also use digital cameras and projectors to design and present the results of their research to their classmates.

Although the Internet is a powerful learning tool, there are potential risks attached to its use. All students must be made aware of issues of Internet privacy, safety, and responsible use, as well as of the potential for abuse of this technology, particularly when it is used to bully or promote hatred.

Teachers will find the various ICT tools useful in their teaching practice, both for whole-class instruction and for the design of curriculum units that contain varied approaches to learning to meet diverse student needs.

PLANNING TECHNOLOGICAL EDUCATION PROGRAMS FOR STUDENTS WITH SPECIAL EDUCATION NEEDS

Classroom teachers are the key educators of students who have special education needs. They have a responsibility to help all students learn, and they work collaboratively with special education resource teachers, where appropriate, to achieve this goal.

Special Education Transformation: The Report of the Co-Chairs with the Recommendations of the Working Table on Special Education, 2006 endorses a set of beliefs that should guide program planning for students with special education needs *in all disciplines*. Those beliefs are as follows:

- All students can succeed.
- Universal design[6] and differentiated instruction[7] are effective and interconnected means of meeting the learning or productivity needs of any group of students.
- Successful instructional practices are founded on evidence-based research, tempered by experience.
- Classroom teachers are key educators for a student's literacy and numeracy development.
- Each student has his or her own unique patterns of learning.
- Classroom teachers need the support of the larger community to create a learning environment that supports students with special education needs.
- Fairness is not sameness.

In any given classroom, students may demonstrate a wide range of strengths and needs. Teachers plan programs that recognize this diversity and give students performance tasks that respect their particular abilities so that all students can derive the greatest possible benefit from the teaching and learning process. The use of flexible groupings for instruction and the provision of ongoing assessment are important elements of programs that accommodate a diversity of learning needs.

In planning technological education courses for students with special education needs, teachers should begin by examining the current achievement level of the individual student, the strengths and learning needs of the student, and the knowledge and skills that all students are expected to demonstrate at the end of the course, in order to determine which of the following options is appropriate for the student:

- no accommodations[8] or modified expectations; or
- accommodations only; or
- modified expectations, with the possibility of accommodations; or
- alternative expectations, which are not derived from the curriculum expectations for a course and which constitute alternative programs and/or courses.

If the student requires either accommodations or modified expectations, or both, the relevant information, as described in the following paragraphs, must be recorded in his or her Individual Education Plan (IEP). More detailed information about planning programs for students with special education needs, including students who require alternative programs and/or courses,[9] can be found in *The Individual Education Plan (IEP): A Resource Guide, 2004* (referred to hereafter as the *IEP Resource Guide, 2004*). For a detailed discussion

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6. The goal of Universal Design for Learning (UDL) is to create a learning environment that is open and accessible to all students, regardless of age, skills, or situation. Instruction based on principles of universal design is flexible and supportive, can be adjusted to meet different student needs, and enables all students to access the curriculum as fully as possible.

7. Differentiated instruction is effective instruction that shapes each student's learning experience in response to his or her particular learning preferences, interests, and readiness to learn.

8. "Accommodations" refers to individualized teaching and assessment strategies, human supports, and/or individualized equipment.

9. Alternative programs are identified on the IEP form by the term "alternative (ALT)".

of the ministry's requirements for IEPs, see *Individual Education Plans: Standards for Development, Program Planning, and Implementation, 2000* (referred to hereafter as *IEP Standards, 2000*). (Both documents are available at www.edu.gov.on.ca.)

Students Requiring Accommodations Only

Some students are able, with certain accommodations, to participate in the regular course curriculum and to demonstrate learning independently. Accommodations allow access to the course without any changes to the knowledge and skills the student is expected to demonstrate. The accommodations required to facilitate the student's learning must be identified in his or her IEP (see *IEP Standards, 2000*, p. 11). A student's IEP is likely to reflect the same accommodations for many, or all, subjects or courses.

Providing accommodations to students with special education needs should be the first option considered in program planning. Instruction based on principles of universal design and differentiated instruction focuses on the provision of accommodations to meet the diverse needs of learners.

There are three types of accommodations:

- *Instructional accommodations* are changes in teaching strategies, including styles of presentation, methods of organization, or use of technology and multimedia.
- *Environmental accommodations* are changes that the student may require in the classroom and/or school environment, such as preferential seating or special lighting.
- *Assessment accommodations* are changes in assessment procedures that enable the student to demonstrate his or her learning, such as allowing additional time to complete tests or assignments or permitting oral responses to test questions (see page 29 of the *IEP Resource Guide, 2004*, for more examples).

If a student requires "accommodations only" in technological education courses, assessment and evaluation of his or her achievement will be based on the appropriate course curriculum expectations and the achievement levels outlined in this document. The IEP box on the student's Provincial Report Card will not be checked, and no information on the provision of accommodations will be included.

Students Requiring Modified Expectations

Some students will require modified expectations, which differ from the regular course expectations. For most students, modified expectations will be based on the regular course curriculum, with changes in the number and/or complexity of the expectations. Modified expectations represent specific, realistic, observable, and measurable achievements and describe specific knowledge and/or skills that the student can demonstrate independently, given the appropriate assessment accommodations.

It is important to monitor, and to reflect clearly in the student's IEP, the extent to which expectations have been modified. As noted in Section 7.12 of the ministry's policy document *Ontario Secondary Schools, Grades 9 to 12: Program and Diploma Requirements, 1999*, the principal will determine whether achievement of the modified expectations constitutes successful completion of the course, and will decide whether the student is eligible to receive a credit for the course. This decision must be communicated to the parents and the student.

When a student is expected to achieve most of the curriculum expectations for the course, the modified expectations should identify *how the required knowledge and skills differ from those identified in the course expectations*. When modifications are so extensive that achievement of the learning expectations (knowledge, skills, and performance tasks) is not likely to result in a credit, the expectations should *specify the precise requirements or tasks on which the student's performance will be evaluated* and which will be used to generate the course mark recorded on the Provincial Report Card.

Modified expectations indicate the knowledge and/or skills the student is expected to demonstrate and have assessed in each reporting period (*IEP Standards, 2000*, pp. 10 and 11). The student's learning expectations must be reviewed in relation to the student's progress at least once every reporting period, and must be updated as necessary (*IEP Standards, 2000*, p. 11).

If a student requires modified expectations in technological education courses, assessment and evaluation of his or her achievement will be based on the learning expectations identified in the IEP and on the achievement levels outlined in this document. If some of the student's learning expectations for a course are modified but the student is working towards a credit for the course, it is sufficient simply to check the IEP box on the Provincial Report Card. If, however, the student's learning expectations are modified to such an extent that the principal deems that a credit will not be granted for the course, the IEP box must be checked and the appropriate statement from the *Guide to the Provincial Report Card, Grades 9–12, 1999* (p. 8) must be inserted. The teacher's comments should include relevant information on the student's demonstrated learning of the modified expectations, as well as next steps for the student's learning in the course.

PROGRAM CONSIDERATIONS FOR ENGLISH LANGUAGE LEARNERS

Ontario schools have some of the most multilingual student populations in the world. The first language of approximately 20 per cent of the students in Ontario's English language schools is a language other than English. Ontario's linguistic heritage includes several Aboriginal languages and many African, Asian, and European languages. It also includes some varieties of English – also referred to as dialects – that differ significantly from the English required for success in Ontario schools. Many English language learners were born in Canada and have been raised in families and communities in which languages other than English, or varieties of English that differ from the language used in the classroom, are spoken. Other English language learners arrive in Ontario as newcomers from other countries; they may have experience of highly sophisticated educational systems, or they may have come from regions where access to formal schooling was limited.

When they start school in Ontario, many of these students are entering a new linguistic and cultural environment. All teachers share in the responsibility for these students' English language development.

English language learners (students who are learning English as a second or additional language in English language schools) bring a rich diversity of background knowledge and experience to the classroom. These students' linguistic and cultural backgrounds not only support their learning in their new environment but also become a cultural asset in the classroom community. Teachers will find positive ways to incorporate this diversity into their instructional programs and into the classroom environment.

Most English language learners in Ontario schools have an age-appropriate proficiency in their first language. Although they need frequent opportunities to use English at school, there are important educational and social benefits associated with continued development of their first language while they are learning English. Teachers need to encourage parents to continue to use their own language at home in rich and varied ways as a foundation for language and literacy development in English. It is also important for teachers to find opportunities to bring students' languages into the classroom, using parents and community members as a resource.

During their first few years in Ontario schools, English language learners may receive support through one of two distinct programs from teachers who specialize in meeting their language-learning needs:

English as a Second Language (ESL) programs are for students born in Canada or newcomers whose first language is a language other than English, or is a variety of English significantly different from that used for instruction in Ontario schools.

English Literacy Development (ELD) programs are primarily for newcomers whose first language is a language other than English, or is a variety of English significantly different from that used for instruction in Ontario schools, and who arrive with significant gaps in their education. These students generally come from countries where access to education is limited or where there are limited opportunities to develop language and literacy skills in any language. Some Aboriginal students from remote communities in Ontario may also have had limited opportunities for formal schooling, and they also may benefit from ELD instruction.

In planning programs for students with linguistic backgrounds other than English, teachers need to recognize the importance of the orientation process, understanding that every learner needs to adjust to the new social environment and language in a unique way and at an individual pace. For example, students who are in an early stage of English-language acquisition may go through a "silent period" during which they closely observe the interactions and physical surroundings of their new learning environment. They may use body language rather than speech or they may use their first language until they have gained enough proficiency in English to feel confident of their interpretations and responses. Students thrive in a safe, supportive, and welcoming environment that nurtures their self-confidence while they are receiving focused literacy instruction. When they are ready to participate, in paired, small-group, or whole-class activities, some students will begin by using a single word or phrase to communicate a thought, while others will speak quite fluently.

With exposure to the English language in a supportive learning environment, most young children will develop oral fluency quite quickly, making connections between concepts and skills acquired in their first language and similar concepts and skills presented in English. However, oral fluency is not a good indicator of a student's knowledge of vocabulary or sentence structure, reading comprehension, or other aspects of language proficiency that play an important role in literacy development and academic success. Research has shown that it takes five to seven years for most English language learners to catch up to their English-speaking peers in their ability to use English for academic purposes. Moreover, the older the children are when they arrive, the greater the amount of language knowledge and skills that they have to catch up on, and the more direct support they require from their teachers.

Responsibility for students' English-language development is shared by the classroom teacher, the ESL/ELD teacher (where available), and other school staff. Volunteers and peers may also be helpful in supporting English language learners in the language class-room. Teachers must adapt the instructional program in order to facilitate the success of these students in their classrooms. Appropriate adaptations include:

- modification of some or all of the subject expectations so that they are challenging but attainable for the learner at his or her present level of English proficiency, given the necessary support from the teacher;
- use of a variety of instructional strategies (e.g., extensive use of visual cues, graphic organizers, and scaffolding; previewing of textbooks; pre-teaching of key vocabu-lary; peer tutoring; strategic use of students' first languages);
- use of a variety of learning resources (e.g., visual material, simplified text, bilingual dictionaries, and materials that reflect cultural diversity);
- use of assessment accommodations (e.g., granting of extra time; use of oral inter-views, demonstrations or visual representations, or tasks requiring completion of graphic organizers or cloze sentences instead of essay questions and other assess-ment tasks that depend heavily on proficiency in English).

When learning expectations in any course are modified for an English language learner (whether the student is enrolled in an ESL or ELD course or not), this information must be clearly indicated on the student's report card.

Although the degree of program adaptation required will decrease over time, students who are no longer receiving ESL or ELD support may still need some program adapta-tions to be successful.

For further information on supporting English language learners, refer to *The Ontario Curriculum, Grades 9–12: English as a Second Language and English Literacy Development, 2007; English Language Learners – ESL and ELD Programs and Services: Policies and Procedures for Ontario Elementary and Secondary Schools, Kindergarten to Grade 12, 2007;* and the resource guides *Supporting English Language Learners with Limited Prior Schooling: A Practical Guide for Ontario Educators, Grades 3 to 12, 2008* and *Many Roots, Many Voices: Supporting English Language Learners in Every Classroom, 2005.*

ANTIDISCRIMINATION EDUCATION IN TECHNOLOGICAL EDUCATION

The implementation of antidiscrimination principles in education influences all aspects of school life. It promotes a school climate that encourages all students to work to attain high standards, affirms the worth of all students, and helps students strengthen their sense of identity and develop a positive self-image. It encourages staff and students alike to value and show respect for diversity in the school and the wider society. It requires schools to adopt measures to provide a safe environment for learning, free from harass-ment, violence, and expressions of hate.

Antidiscrimination education encourages students to think critically about themselves and others in the world around them in order to promote fairness, healthy relationships, and active, responsible citizenship.

Schools have the responsibility to ensure that school–community interaction reflects the diversity in the local community and wider society. Consideration should be given to a variety of strategies for communicating and working with parents and community members from diverse groups, in order to ensure their participation in such school activities as technology fairs, plays, and teacher interviews. Families new to Canada, who may be unfamiliar with the Ontario school system, or parents of Aboriginal students may need special outreach and encouragement in order to feel comfortable in their interactions with the school.

When planning instructional activities for technological education, teachers should base their decisions on the needs of students, taking into consideration the diversity of their abilities, backgrounds, interests, and learning styles. Teaching strategies, assessment and evaluation materials, and the classroom environment should be designed to value the experiences and contributions of all people.

Participation rates in some technological education subjects tend to be higher for male students than female students. To encourage greater participation among female students, it may be helpful to offer more projects and activities that have socially meaningful applications. For example, projects to develop assistive devices, as opposed to the more traditional activity of creating robotic arms, have proved successful in engaging the interest of female students. Similarly, projects involving the construction of playground equipment as opposed to the more traditional sheds and building structures may hold more appeal for young women. Providing outreach programs and establishing study groups for young women may help them develop greater self-confidence in technological education. Technology fairs and showcase events can introduce all students to a wide range of technology activities, and may encourage an interest in technological education. Offering choices from a range of instructional activities or allowing students to select their own projects can help motivate all the students in a classroom by acknowledging the differences in their experiences, attitudes, and interests.

It is important to have open and frank discussions about the kind of workplace environment students are likely to encounter in technological fields. Inviting female and visible minority role models who have had successful careers in various technology sectors to be guest speakers, and involving female and visible minority senior students as mentors, can have a very positive impact on students. Also, exploring strategies that would enable those with different learning and social styles, including Aboriginal students and students from other minority groups, to work effectively together will help establish a more inclusive working environment.

ENVIRONMENTAL EDUCATION IN TECHNOLOGICAL EDUCATION

Environmental education is education about the environment, for the environment, and in the environment that promotes an understanding of, rich and active experience in, and an appreciation for the dynamic interactions of:

- *the Earth's physical and biological systems*

- *the dependency of our social and economic systems on these natural systems*

- *the scientific and human dimensions of environmental issues*

- *the positive and negative consequences, both intended and unintended, of the interactions between human-created and natural systems.*

Shaping Our Schools, Shaping Our Future:
Environmental Education in Ontario Schools (June 2007), p. 6

As noted in *Shaping Our Schools, Shaping Our Future*, environmental education "is the responsibility of the entire education community. It is a content area and can be taught. It is an approach to critical thinking, citizenship, and personal responsibility, and can be modelled. It is a context that can enrich and enliven education in all subject areas and offer students the opportunity to develop a deeper connection with themselves, their role in society, and their interdependence on one another and the Earth's natural systems" (p. 10).

There are many opportunities to integrate environmental education into the teaching of technological education. In each of the technological education courses, the expectations in the Technology/Industry Practices, the Environment, and Society strand allow students to develop critical thinking skills and an understanding of responsible practice with respect to the environmental implications of the technology they are studying. Students analyse the impact of technology on the environment and learn about the safe handling and disposal of materials and substances used in the development of products and the provision of services. In this way, students are able to explore how simple human interactions with the environment can have significant consequences. Students will be expected to actively engage in developing and implementing strategies to reduce, reuse, and recycle materials and products, and will learn about government agencies and community partners that have developed relevant opportunities to support such practices. By identifying and implementing measures to reduce the negative effects of technology on the environment, students will be contributing to responsible environmental stewardship.

The dynamic relationships resulting from human interaction with the environment provide a rich context for developing authentic learning activities in technological education courses. Technological education projects can readily be designed to integrate content and principles relevant to environmental education. For example, students can be engaged in constructing solar-powered devices, designing recycling centres, or creating media projects that focus on environmental awareness.

LITERACY, MATHEMATICAL LITERACY, AND INQUIRY/RESEARCH SKILLS

Literacy, mathematical literacy, and inquiry/research skills are critical to students' success in all subjects of the curriculum and in all areas of their lives.

Many of the activities and tasks that students undertake in the technological education curriculum involve the literacy skills relating to oral, written, and visual communication. For example, students use language to describe their plans and the progress of their designs and projects in both informal and formal contexts, to produce work orders, and to report on the results of their projects in presentations and technical and other reports in oral, written, graphic, and multimedia forms. Technological education also requires the use and understanding of specialized terminology. In all technological education courses, students are required to use appropriate and correct terminology, and are encouraged to use language with care and precision in order to communicate effectively.

The technological education program also builds on, reinforces, and enhances mathematical literacy. For example, clear, concise communication often involves the use of diagrams, tables, and graphs, and many components of the technological education curriculum emphasize students' ability to interpret and use symbols and charts. Students are also required to take accurate measurements, produce plans to specified dimensions, and use metric and imperial systems of measurement, as required in their particular area of study.

Inquiry and research are at the heart of learning in all subject areas. In technological education courses, students are encouraged to develop their ability to analyse the context and background of challenges and to explore a variety of possible solutions to those challenges. As students advance through the grades, they acquire the skills to locate information relevant to solving problems and addressing challenges from a variety of sources, such as books, magazines, manuals, technical reports, dictionaries, client interviews, videos, and the Internet. As students in technological education courses conduct such research, teachers should guide them in recognizing that all sources of information have a particular point of view and that the recipient of the information has a responsibility to evaluate that information, determine its validity and relevance, and use it in appropriate ways. The ability to locate, question, and evaluate information allows a student to become an independent, lifelong learner.

CAREER EDUCATION

Ongoing discoveries and innovations coupled with rapidly evolving technologies have resulted in an exciting environment in which creativity and innovation thrive, bringing about new career opportunities. Today's employers seek candidates with strong technical skills, critical-thinking and problem-solving skills, and the ability to work cooperatively in a team, traits that are developed through participation in technological education. Technological education courses enable students to develop problem-solving skills, design skills, technical knowledge and skills, and the ability to conduct research, present results, and work on projects both independently and in a team environment.

COOPERATIVE EDUCATION AND OTHER FORMS OF EXPERIENTIAL LEARNING

Cooperative education and other forms of experiential learning, such as job shadowing, field trips, and work experience, are central to technological education, enabling students to apply the skills they have developed in the classroom to real-life activities in the community and in the world of technological innovation. Cooperative education and other workplace experiences also help to broaden students' knowledge of employment opportunities in a wide range of fields, including industrial, motive power, construction, service, and agricultural trades; engineering; hospitality and tourism; and health care. In addition, students develop their understanding of workplace practices, certifications, and the nature of employer–employee relationships. Teachers of technological education can support their students' learning by maintaining links with community-based businesses to ensure that students have access to hands-on experiences that will reinforce the knowledge and skills gained in school.

Students who choose a technological education course as the related course for two cooperative education credits are able, through this packaged program, to meet the group 1, 2, and 3 compulsory credit requirements for the OSSD.

Health and safety issues must be addressed when learning involves cooperative education and other workplace experiences. Teachers who provide support for students in workplace learning placements need to assess placements for safety and ensure that students understand the importance of issues relating to health and safety in the workplace. Before taking part in workplace learning experiences, students must acquire the knowledge and skills needed for safe participation. Students must understand their rights to privacy and confidentiality as outlined in the Freedom of Information and Protection of Privacy Act. They have the right to function in an environment free from abuse and harassment, and they need to be aware of harassment and abuse issues in establishing boundaries for their own personal safety. They should be informed about school and community resources and school policies and reporting procedures with respect to all forms of abuse and harassment.

Policy/Program Memorandum No. 76A, "Workplace Safety and Insurance Coverage for Students in Work Education Programs" (September 2000), outlines procedures for ensuring the provision of Health and Safety Insurance Board coverage for students who are at least 14 years of age and are on placements of more than one day. (A one-day job-shadowing or job-twinning experience is treated as a field trip.) Teachers should also be aware of the minimum age requirements outlined in the Occupational Health and Safety Act for persons to be in or to be working in specific workplace settings. All cooperative education and other workplace experiences will be provided in accordance with the ministry's policy document *Cooperative Education and Other Forms of Experiential Learning: Policies and Procedures for Ontario Secondary Schools, 2000.*

PLANNING PROGRAM PATHWAYS AND PROGRAMS LEADING TO A SPECIALIST HIGH SKILLS MAJOR

Technological education courses are well suited for inclusion in some programs leading to a Specialist High Skills Major (SHSM) or in programs designed to provide pathways to particular apprenticeship or workplace destinations. In some SHSM programs, technological education courses can be bundled with other courses to provide the academic knowledge and skills important to particular industry sectors and required for success in the workplace and postsecondary education, including apprenticeship. Technological education courses may also be combined with cooperative education credits to provide the workplace experience required for some SHSM programs and for various program pathways to apprenticeship and workplace destinations. SHSM programs would also include sector-specific learning opportunities offered by employers, skills-training centres, colleges, and community organizations.

COURSES

COMMUNICATIONS TECHNOLOGY

Communications technology affects all aspects of our lives in a fundamental way. Having an understanding of communications technology is an important part of being both technologically and media literate.

Communications technology courses are project-based and will provide students with opportunities to acquire the knowledge and skills required to design, use, and manage electronic, live, recorded, and graphic communications systems, specifically in the areas of TV, video, and movie production; radio and audio production; print and graphic communications; photography; digital imaging; broadcast journalism; and interactive new media and animation. These courses will help students understand the effects of communications technology on the environment and society. Students will also examine standards and regulations governing communications technology, health and safety issues, careers in the field, and the importance of lifelong learning, and will learn about the Essential Skills and work habits that are important for success in careers in the field.

The list of approved emphasis areas for communications technology can be found at www.edu.gov.on.ca/eng/curriculum/secondary/teched.html.

- Courses in technological education are suitable for use in cooperative education programs and in connection with other forms of experiential learning as well as in programs such as the Specialist High Skills Major (SHSM). For more information, see pages 43–44 of this document.
- For policy guidelines pertaining to multiple-credit courses and emphasis courses, see pages 17–18 of this document.

Communications Technology, Grade 11

University/College Preparation   TGJ3M

This course examines communications technology from a media perspective. Students will develop knowledge and skills as they design and produce media projects in the areas of live, recorded, and graphic communications. These areas may include TV, video, and movie production; radio and audio production; print and graphic communications; photography; digital imaging; broadcast journalism; and interactive new media. Students will also develop an awareness of related environmental and societal issues, and will explore college and university programs and career opportunities in the various communications technology fields.

Prerequisite: None

A. COMMUNICATIONS TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of the core concepts, techniques, and skills required to produce a range of communications media products and services;

A2. demonstrate an understanding of different types of equipment and software and how they are used to perform a range of communications technology operations and tasks;

A3. demonstrate an understanding of technical terminology, scientific concepts, and mathematical concepts used in communications technology and apply them to the creation of media products;

A4. demonstrate an understanding of and apply the interpersonal and communication skills necessary to work in a team environment.

SPECIFIC EXPECTATIONS

A1. Core Concepts, Techniques, and Skills

By the end of this course, students will:

A1.1 demonstrate an understanding of design principles *(e.g., balance, rhythm, proportion, contrast, and flow)* and elements *(e.g., colour, line, space, form, and texture)* and their role in creating effective media products *(e.g., use of colour in photography, balance in a layout, continuity in an audio or video production, proportion and contrast in typography)*;

A1.2 demonstrate an understanding of the concepts *(e.g., video and photography composition, appropriate audio levels, audio and video continuity, animation fluidity, balanced layout, basic lighting)* and creative techniques *(e.g., lighting, image manipulation and editing, composition and framing)* required to produce effective media products or services;

A1.3 identify the components of a communications system *(e.g., cameras, lenses, filters, editing software, printer in a photographic system; microphones, connectors, mixers, recorders in an audio system; desktop publishing software and platesetter in a computer-to-plate system)* and describe their functions;

A1.4 identify different types of communications software *(e.g., software for photo, audio, and video editing, animation, page layout, web page creation, and computer graphics)*, and describe how they are used to produce communications technology products and services.

A2. Equipment and Software

By the end of this course, students will:

A2.1 identify the components and controls of different types of communications devices *(e.g., lens, mirror, sensor, command dial, mode selector in a digital SLR; plate cylinder, blanket cylinder, impression cylinder, ink keys in an offset press)* and describe their functions;

A2.2 use application software and/or equipment competently to perform a variety of communications tasks *(e.g., inputting, manipulating, and outputting sounds and images; embedding and linking graphics in an interactive portable document; posting media on the Internet)*.

A3. Technical Terminology and Scientific and Mathematical Concepts

By the end of this course, students will:

A3.1 demonstrate an understanding of communications technology terms, and use them correctly in oral and written communication *(e.g., kerning, framing, key frame, jump cut, peaking, video switch-*

ing, audio levels, dissolve, resolution, masking, file management, storyboard);

A3.2 demonstrate a basic understanding of scientific concepts that relate to processes and technologies used in communications technology *(e.g., light and colour theory, acoustic theory, persistence of vision, sensor operation);*

A3.3 use appropriate formulas and calculations to solve problems in pre-production, production, and post-production work *(e.g., calculating frame rates, timelines, resolutions, file compression ratios, scaling).*

A4. Teamwork

By the end of this course, students will:

A4.1 explain the benefits of listening, encouraging participation, and sharing information, resources, and expertise when working in a team setting;

A4.2 describe and apply concepts and techniques that facilitate effective collaboration in a team environment *(e.g., cooperative discussion, conflict resolution techniques, providing opportunities for all to participate, listening, respecting the ideas of others, constructive criticism).*

B. COMMUNICATIONS TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. apply project management techniques to develop communications technology products effectively in a team environment;

B2. apply a design process or other problem-solving processes or strategies to meet a range of challenges in communications technology;

B3. create productions that demonstrate competence in the application of creative and technical skills and incorporate current standards, processes, formats, and technologies.

SPECIFIC EXPECTATIONS

B1. Project Management

By the end of this course, students will:

B1.1 describe the roles that are required for effective management of team-based projects (*e.g., scheduler, budget controller, secretary/coordinator*) and apply coordination techniques (*e.g., meeting regularly to review progress and make decisions, forming task groups to deal with special issues*);

B1.2 use a variety of planning techniques and tools (*e.g., research, design briefs, task lists, scripts, mock-ups, storyboards, site maps, project-planning software*) when creating plans for communications projects;

B1.3 use appropriate organizational and time-management tools (*e.g., student planners, journals, electronic organizers, organizational software*) throughout the project to manage resources and ensure that project deadlines are met;

B1.4 use a variety of techniques (*e.g., comparing outcomes to specifications*) to evaluate the results of the project management process.

B2. Problem Solving

By the end of this course, students will:

B2.1 define a problem or challenge precisely and in adequate detail, taking into account relevant contextual or background information;

B2.2 define project objectives and performance criteria precisely and in adequate detail, and

identify constraints such as cost, time, or technology restrictions that will limit design or problem-solving options;

B2.3 use a variety of information sources and research techniques to help identify possible solutions (*e.g., Internet and library searches, checking manuals and other printed materials, consulting experts*);

B2.4 use idea-generating techniques such as brainstorming or clarification techniques such as situation analyses to help identify possible solutions;

B2.5 use charts or hand-drawn sketches to organize sequences, clarify relationships, or compare alternatives;

B2.6 evaluate possible solutions to identify those that most effectively meet the objectives and criteria within the existing constraints.

B3. Process and Production Skills

By the end of this course, students will:

B3.1 use appropriate procedures to set up and operate media production equipment (*e.g., audio, video, or graphic systems; studio lighting systems; electronic pre-press equipment; printing systems*);

B3.2 use appropriate software applications (*e.g., computer graphics, photo editing, video editing*) to complete a variety of tasks associated with designing communications media;

B3.3 demonstrate an understanding of industry guidelines, conventions, rules, and standards and apply them to the production of communications media products *(e.g., standards for legibility, type measurement, and letter spacing in graphic design; video resolution standards [standard versus high definition] and colour standards* *[NTSC versus ATSC] for TV; colour proofing guidelines for printing; resolution, readability, file size, browser compatibility, and accessibility standards for websites).*

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. describe the impact of current communications media technologies and activities on the environment and identify ways of reducing harmful effects;

C2. demonstrate an understanding of the social effects of current communications media technologies and the importance of respecting cultural and societal diversity in the production of media projects.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 describe the impact of current communications media technologies on the environment *(e.g., increased energy consumption, disposal of electronic equipment and batteries, noise pollution, electromagnetic interference, RF pollution, chemical and other wastes associated with paper production)*;

C1.2 describe environmentally responsible practices that can be used to reduce the impact of communications technologies on the environment *(e.g., recycling or finding new uses for obsolete equipment, disposal of batteries as toxic waste, using energy-efficient equipment and turning off equipment that is not being used, recycling of toner cartridges, use of recycled paper)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 demonstrate an understanding of social standards and cultural sensitivity and use appropriate and inclusive content, images, and language in communications media productions *(e.g., including people from different races, cultures, and backgrounds in media productions; portraying minority groups with respect and sensitivity; avoiding sexism, homophobia, and cultural or racial bias)*;

C2.2 describe the effects of current trends in communications technology *(e.g., interactivity, on-demand programming, user-generated content, specialty channels such as the Aboriginal Peoples' Television Network)* on society and different cultures within society.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and apply safe work practices when performing communications technology tasks;

D2. demonstrate an understanding of and adhere to legal requirements and ethical standards relating to the communications technology industry;

D3. identify careers in communications technology for which postsecondary education is required or advantageous, and describe college and university programs that prepare students for entry into these occupations.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 describe industry hazards *(e.g., ergonomic hazards, electrical hazards, mechanical hazards)*, identify sources of hazard information *(e.g., Workplace Hazardous Materials Information System [WHMIS], Passport to Safety)*, and describe methods of preventing accidents *(e.g., safety audits, regular retraining in safety procedures)*;

D1.2 demonstrate an understanding of and apply safe work practices when performing communications technology tasks *(e.g., use of safe procedures for lighting set-up, cable management, computer operation, and ladder use; use of ergonomic equipment and practices)*.

D2. Professional Standards and Ethics

By the end of this course, students will:

D2.1 demonstrate an understanding of and adhere to laws applicable to creative content *(e.g., laws governing copyright and other creative property rights, domain names, privacy, defamation)*;

D2.2 describe privacy and security issues related to the use of communications media technology;

D2.3 demonstrate an understanding of and adhere to ethical standards relating to the creation of media products *(e.g., restrictions on appropriation of content and image manipulation)* and to their dissemination *(e.g., honesty in advertising)*.

D3. Career Opportunities

By the end of this course, students will:

D3.1 describe careers in communications technology for which postsecondary education is required or advantageous, and identify the qualifications required for entry into these occupations;

D3.2 describe university and college programs that prepare students for careers in communications technology, and identify the qualifications required for entry into these programs;

D3.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the communications technology industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D3.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the communications technology industry, as identified in the Ontario Skills Passport *(e.g., reading text, oral communication, job task planning and organizing, problem solving, finding information)*;

D3.5 demonstrate an understanding of and apply the work habits that are important for success in the communications technology industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability, initiative, customer service, entrepreneurship)*;

D3.6 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in communications technology *(e.g., work logs, skills checklist, photographs, digital media, sketches, drawings)*, and explain why having a current portfolio is important for career development and advancement.

Communications Technology: Broadcast and Print Production, Grade 11

Open   TGJ3O

This course enables students to develop knowledge and skills in the areas of graphic communication, printing and publishing, audio and video production, and broadcast journalism. Students will work both independently and as part of a production team to design and produce media products in a project-driven environment. Practical projects may include the making of signs, yearbooks, video and/or audio productions, newscasts, and documentaries. Students will also develop an awareness of related environmental and societal issues, and will explore secondary and postsecondary education and training pathways and career opportunities in the various communications technology fields.

Prerequisite: None

A. COMMUNICATIONS TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of the core concepts, techniques, and skills required to produce a range of audio, video, broadcast journalism, graphic arts, and printing and publishing products or services;

A2. demonstrate an understanding of technical terminology, scientific concepts, and mathematical concepts used in audio and video production, broadcast journalism, graphic arts, and printing and publishing, and apply them to the creation of media products;

A3. demonstrate an understanding of and apply the interpersonal skills necessary to work effectively in a team setting.

SPECIFIC EXPECTATIONS

A1. Core Concepts, Techniques, and Skills

By the end of this course, students will:

A1.1 demonstrate an understanding of technological concepts (*e.g., aesthetics, control, environmental sustainability, ergonomics, fabrication/building/ creation, function, innovation, material, mechanism, power and energy, safety, structure, systems*) and their relevance to the design and creation of media projects (see pp. 7–8);

A1.2 use audio, video, broadcast journalism, graphic arts, and publishing equipment safely and correctly to perform basic production tasks or create simple products (*e.g., shoot footage with a video camera, set up microphones, operate a sound board, print a pamphlet on various printing devices*);

A1.3 use video editing, audio editing, graphic arts, and publishing software correctly to perform basic production tasks or create simple products (*e.g., use dissolves and fades, stop motion; add titles; create simple layouts, logos*);

A1.4 demonstrate an understanding of the creative skills and techniques required to produce effective video, audio, broadcast journalism, graphic arts, and print products (*e.g., lighting techniques, recording techniques, blocking techniques, editing techniques, interviewing and journalistic writing techniques, colour matching*);

A1.5 identify the components of audio, video, graphic arts, and printing systems (*e.g., video cameras, editing software, switchers, microphones, audio mixers, computers, monitors, platesetters, different types of presses [offset, flexographic, gravure, letterpress], inkjet and electrostatic printers, bindery equipment*) and devices (*e.g., camera controls, sensor, recording media, connectors, toner, roller, ozone filter*), and describe their functions;

A1.6 use safe and appropriate methods for installing, transporting, and storing audio, video, broadcast journalism, and graphic arts equipment (*e.g., cameras, tripods, lights, microphones, teleprompters, portable mixers, cables, scanners*) and setting up printing equipment;

A1.7 apply design principles (*e.g., balance, rhythm, proportion, contrast, and flow*) and elements (*e.g., colour, line, space, form, and texture*) to communicate an idea or concept.

A2. Technical Terminology and Scientific and Mathematical Concepts

By the end of this course, students will:

A2.1 demonstrate an understanding of terminology related to video and audio production, broadcast journalism, graphic arts, and publishing, and use it correctly in oral and written communication (*e.g., sampling rate, aspect ratio, headroom, continuity, offline media, closure, voice-over, tag, spot colour, colour mode*);

A2.2 demonstrate an understanding of scientific concepts that relate to processes and technologies used in video and audio production and printing *(e.g., behaviour of light; conversion of light and sound to electricity and back; digital encoding of light, sound, and data; persistence of vision; principles of various printing technologies such as inkjet, electrostatic, and offset);*

A2.3 use mathematical concepts and formulas as required to complete tasks in audio and video production, graphic arts, and print production *(e.g., calculation of lighting ratios and exposures, timing of sequences in audio and video editing, image scaling, imposition planning).*

A3. Teamwork

By the end of this course, students will:

A3.1 explain the value of sharing ideas, information, resources, and expertise when working in a team setting;

A3.2 describe and use techniques that encourage participation by all members of a team *(e.g., brainstorming, group discussion, celebration of others' thoughts or contributions);*

A3.3 describe and use concepts and techniques that facilitate effective collaboration in a team environment *(e.g., cooperative discussion, conflict resolution techniques, motivation techniques, respect for the ideas of others, constructive criticism).*

B. COMMUNICATIONS TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. apply project management techniques to the planning and development of audio, video, broadcast journalism, graphic arts, and printing products;

B2. apply a design process or other problem-solving processes or strategies to meet a range of challenges in creating audio, video, broadcast journalism, graphic arts, and printing products;

B3. create products or productions that demonstrate competence in the application of creative and technical skills.

SPECIFIC EXPECTATIONS

B1. Project Management

By the end of this course, students will:

B1.1 use a variety of planning techniques and tools *(e.g., research, project proposals, storyboards, script treatments)* when creating plans for an audio, video, broadcast journalism, graphic arts, and/or printing project;

B1.2 use appropriate organizational and time-management tools *(e.g., student planners, journals, production schedules, electronic organizers, organizational software)* throughout the project to manage resources and ensure that project deadlines are met.

B2. Problem Solving

By the end of this course, students will:

B2.1 apply the steps in a design process to develop solutions to creative challenges *(e.g., define the problem or challenge, taking into account relevant contextual or background information; define project objectives and criteria and identify constraints such as cost, time, or technology limitations; gather information and generate possible solutions using techniques such as brainstorming; evaluate possible solutions and apply the one that most effectively meets the objectives and criteria within the existing constraints)* (see pp. 22–23);

B2.2 apply appropriate problem-solving approaches and/or techniques to solve specific technical problems *(e.g., diagnostics, reverse engineering, trial and error, divide and conquer, parts substitution, extreme cases)*.

B3. Process and Production Skills

By the end of this course, students will:

B3.1 apply creative skills, equipment operating skills, and software skills to create components for a media production *(e.g., news copy, video footage, voice-overs for a TV news broadcast; text, images, page layouts for a publication)*;

B3.2 apply editing skills to integrate the components into a unified and effective production.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. describe the impact of communications media technologies and activities on the environment, and identify ways of reducing their harmful effects;

C2. demonstrate an understanding of social effects and issues arising from the use of communications media technologies and the importance of respecting cultural and societal diversity in the production of media projects.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 describe the effects of current audio, video, broadcast journalism, graphic arts, and printing technologies on the environment *(e.g., increased energy consumption, waste and disposal problems created by rapid obsolescence, toxic wastes, noise pollution, electromagnetic interference, RF pollution)*;

C1.2 describe ways in which environmental problems are being or can be addressed by the audio, video, broadcast journalism, graphic arts, and printing industries *(e.g., using energy-efficient equipment, upgrading rather than replacing obsolete equipment, recycling equipment slated for disposal, using environmentally friendly inks and environmentally responsible press cleanup methods, using the persuasive power of the media to promote environmental stewardship, environmental certification of operations [EcoLogo, ISO 14001])*.

C2. Technology and Society

By the end of this course, students will:

C2.1 demonstrate an understanding of social standards and cultural sensitivity and use appropriate and inclusive content, images, and language in communications media productions *(e.g., including people from different races, cultures, and backgrounds in media productions; portraying minority groups with respect and sensitivity; avoiding sexism, homophobia, and cultural or racial bias)*;

C2.2 identify legal and ethical issues related to communications media production *(e.g., copyright, respect of privacy and personal information)*;

C2.3 identify recent innovations in audio, video, broadcast journalism, graphic arts, and printing technologies *(e.g., increasing affordability and ease of use of high-quality equipment; development of software for performing complex tasks)* and describe their social and economic effects *(e.g., new opportunities for small businesses to produce CDs, videos, and other products; weakening of the traditional newspaper and magazine market; new opportunities to reach specialized audiences through short-run publishing; new opportunities for Aboriginal or other ethnocultural or social groups to promote their culture and points of view; decline of old technology businesses and rise of new technology businesses)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and apply safe work practices in the use of audio, video, broadcast journalism, graphic arts, and printing equipment;

D2. identify careers in audio and video production, broadcast journalism, graphic arts, and printing and publishing, and describe the skills, work habits, education, and training required for entry into employment in these fields.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 describe industry hazards *(e.g., ergonomic hazards, electrical hazards, mechanical hazards)*, identify sources of hazard information *(e.g., Workplace Hazardous Materials Information System [WHMIS], Passport to Safety)*, and describe methods for preventing accidents;

D1.2 demonstrate an understanding of and apply safe work practices when using equipment *(e.g., use of gloves and other protective clothing, correct seat placement, use of proper cable management techniques, use of ergonomically designed equipment, proper grounding of electrical devices, use of safety chains, correct use of ladders, proper use and storage of equipment)*;

D1.3 describe health risks *(e.g., carpal tunnel syndrome, eye strain)* associated with the use of audio, video, broadcast journalism, graphic arts, and printing equipment, and identify ways of avoiding them.

D2. Career Opportunities

By the end of this course, students will:

D2.1 identify career opportunities in audio and video production, broadcast journalism, graphic arts, and printing and publishing *(e.g., director, announcer, videographer, journalist, graphic illustrator, printer)* and describe the qualifications and skills needed for entry into these occupations;

D2.2 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the audio and video production, broadcast journalism, graphic arts, and printing and publishing industries *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.3 demonstrate an understanding of and apply the Essential Skills that are important for success in the audio and video production, broadcast journalism, graphic arts, and printing and publishing industries, as identified in the Ontario Skills Passport *(e.g., computer use, oral communication, measurement and calculation, numerical estimation, job task planning and organizing, decision making)*;

D2.4 demonstrate an understanding of and apply the work habits that are important for success in the audio and video production, broadcast journalism, graphic arts, and printing and publishing industries, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability, initiative, customer service, entrepreneurship)*;

D2.5 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in audio and video production, broadcast journalism, graphic arts, and/or printing and publishing *(e.g., work logs, skills checklist, photographs, digital media, sketches, drawings)*, and explain why having a current portfolio is important for career development and advancement.

Communications Technology, Grade 12

University/College Preparation   TGJ4M

This course enables students to further develop media knowledge and skills while designing and producing projects in the areas of live, recorded, and graphic communications. Students may work in the areas of TV, video, and movie production; radio and audio production; print and graphic communications; photography; digital imaging; broadcast journalism; and interactive new media. Students will also expand their awareness of environmental and societal issues related to communications technology, and will investigate career opportunities and challenges in a rapidly changing technological environment.

Prerequisite: Communications Technology, Grade 11, University/College Preparation

A. COMMUNICATIONS TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of advanced concepts, techniques, and skills required to produce a range of communications media products and services;

A2. describe different types of equipment and software and explain how they are used in creating communications media products;

A3. demonstrate an understanding of technical terminology, scientific concepts, and mathematical concepts used in communications technology, and apply them to the creation of media products;

A4. demonstrate an understanding of and apply the interpersonal and communications skills necessary to work in a team environment.

SPECIFIC EXPECTATIONS

A1. Core Concepts, Techniques, and Skills

By the end of this course, students will:

A1.1 demonstrate an understanding of advanced concepts *(e.g., floor direction, broadcast script writing, foley and soundtrack production, high dynamic range photography, advanced studio lighting)* and creative and production techniques *(e.g., pre-press workflow, image optimization, photo workflow, streaming media production)* used to produce a range of communications products or services;

A1.2 describe the characteristics of interfaces *(e.g., USB, IEEE 1394, optical connector)* used to connect components of a communications system *(e.g., video or digital cameras to computers, computers to printers, microphones to sound mixing and processing equipment)*;

A1.3 operate communications technology equipment and devices correctly and use software applications effectively to perform a variety of production tasks *(e.g., select appropriate formats and aspect ratios for video productions; control digital video and audio equipment such as video monitors, cameras, DVD recorders, scanners, microphones, and computers)*.

A2. Equipment and Software

By the end of this course, students will:

A2.1 describe different types of communications devices and their components *(e.g., cameras, lighting equipment, audio and video recorders, audio mixers, scanners, printing equipment)* and explain how they are used to produce communications products and services;

A2.2 demonstrate a thorough understanding of different types of communications software *(e.g., software for photo, audio, and video editing, animation, page layout, web page creation, and computer graphics)* and their application in the production of various communications products.

A3. Technical Terminology and Scientific and Mathematical Concepts

By the end of this course, students will:

A3.1 demonstrate an understanding of communications technology terms, and use them correctly in oral and written communication *(e.g., kerning, framing, key frame, jump cut, peaking, video switching, audio levels, dissolve, signals, layers, vector, file formats, proofs, file management and compression, headroom, noseroom, voice-overs)*;

A3.2 demonstrate an understanding of scientific concepts that relate to processes and technologies used in communications technology *(e.g., light and colour theory, digital encoding of light and sound, fibre optics, operation of image sensors, principles of various printing technologies [offset, gravure, flexographic, letterpress, inkjet, electrostatic])*;

A3.3 use appropriate formulas and calculations to solve problems in pre-production, production, and post-production work *(e.g., calculating frame rates, timelines, resolutions, file compression ratios)*.

A4. Teamwork

By the end of this course, students will:

A4.1 describe and apply a variety of team-building strategies *(e.g., cooperative discussion, collaboration strategies, conflict resolution strategies, motivational strategies, respect for the ideas of others)*;

A4.2 demonstrate an understanding of and apply techniques for encouraging collaboration and building consensus *(e.g., sharing information, resources, and expertise; providing opportunities for all to participate; listening)*;

A4.3 demonstrate an understanding of leadership techniques *(e.g., provide clear expectations, recognize contributions, value opinions, communicate progress, criticize constructively)* and apply them in a team setting.

B. COMMUNICATIONS TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. apply project management techniques to the planning and development of communications media projects;

B2. apply a design process or other problem-solving processes or strategies to meet a range of challenges in communications technology;

B3. create products or productions that demonstrate competence in the application of creative and technical skills and incorporate current and evolving standards, processes, formats, and technologies.

SPECIFIC EXPECTATIONS

B1. Project Management

By the end of this course, students will:

B1.1 use a variety of planning techniques and tools *(e.g., research, project proposals, design briefs, storyboards, site maps, production schedules)* when creating plans for communications technology projects;

B1.2 use a variety of software applications to manage time and resources throughout a project *(e.g., scheduling software to produce production schedules and track progress, spreadsheet software to produce equipment availability lists and edit decision lists)*;

B1.3 use review procedures to measure progress and adapt plans and processes as necessary to ensure timely and accurate completion of projects.

B2. Problem Solving

By the end of this course, students will:

B2.1 define a problem or challenge precisely and in adequate detail, taking into account relevant contextual or background information;

B2.2 define project objectives and performance criteria precisely and in adequate detail, and assess the effects of constraints such as cost, time, or technology restrictions that will limit design or problem-solving options;

B2.3 use a variety of information sources and research techniques to help identify possible solutions *(e.g., conducting Internet and library searches, checking manuals and other printed materials, consulting experts)*;

B2.4 use idea-generating techniques such as brainstorming, or clarification techniques such as situation analyses, to help identify possible solutions;

B2.5 use charts or hand-drawn sketches to organize sequences, clarify relationships, or compare alternatives;

B2.6 evaluate possible solutions to identify those that most effectively meet the objectives and criteria within the existing constraints.

B3. Process and Production Skills

By the end of this course, students will:

B3.1 use advanced procedures to set up and operate media production equipment *(e.g., cameras, lighting equipment, audio and video recorders, audio mixers, video switchers, scanners, printing equipment, camera supports)*;

B3.2 apply creative skills, equipment operating skills, and software skills to create and integrate components for a media production *(e.g., news copy, video footage, voice-overs, graphics, animations for a TV news broadcast)*;

B3.3 demonstrate an understanding of and apply industry standards for technical manipulations *(e.g., lighting, colour balance)* and calibrations *(e.g., input and output devices, monitors)*;

B3.4 produce rich media products that conform to evolving industry standards and formats *(e.g., interactive graphics, streamed video, radio broadcasts)*.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. analyse the environmental impact of recent advances in communications technology, and describe ways of reducing harmful effects;

C2. demonstrate an understanding of the effects of communications technology and media activities on society and cultural diversity.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 analyse the environmental costs and benefits, local and global, of recent innovations in communications technology *(e.g., costs and benefits related to resource usage, energy demand, waste disposal, toxic substances, radiation, air and water pollution)*;

C1.2 describe ways of minimizing or avoiding harmful environmental effects caused by communications technologies and media activities *(e.g., upgrade products rather than dispose of them; turn off equipment that is not being used; treat dead batteries as toxic waste; recycle used paper and printer cartridges)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 describe how cultural diversity can be reflected in media products *(e.g., by offering specific programming for narrowcasting to different cultural groups, creating content in minority languages, choosing project topics that reflect the interests of diverse communities, using inclusive content and images)*;

C2.2 evaluate the societal and cultural effects of converging and emerging technologies *(e.g., in digital imaging, interface design, interactive media)* from various perspectives *(e.g., the head of an established business, an entrepreneur, a media worker, a consumer)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and apply safe work practices when performing communications technology tasks;

D2. demonstrate an understanding of and adhere to legal requirements and ethical practices relating to the communications technology industry;

D3. demonstrate an understanding of career opportunities and career development in a rapidly changing technological environment, and maintain a portfolio of their work as evidence of their qualifications for future education and employment.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 describe industry hazards *(e.g., ergonomic, mechanical, electrical, and chemical hazards)*, identify sources of hazard information *(e.g., Workplace Hazardous Materials Information System [WHMIS], Passport to Safety)*, and describe methods of preventing accidents *(e.g., safety audits, regular safety training)*;

D1.2 demonstrate an understanding of and apply safe work practices *(e.g., using ergonomically designed equipment and work areas, keeping equipment in proper working order, maintaining a well-organized workplace, using lockout procedures when installing or maintaining equipment, wearing gloves when handling hot lights, using a spotter when climbing ladders, keeping liquids away from electronic equipment)* when performing communications technology procedures.

D2. Professional Standards and Ethics

By the end of this course, students will:

D2.1 describe various ways in which ownership may exist and be protected in creative, intellectual, or artistic works *(e.g., copyright, trademarks, patents)*;

D2.2 use appropriate methods to reference the words, ideas, information, research, or findings of others *(e.g., footnotes, endnotes, parenthetical references, bibliographies, credit lists, acknowledgements, permission lists)*.

D3. Career Opportunities

By the end of this course, students will:

D3.1 describe career opportunities in existing, converging, and emerging communications technologies *(e.g., digital imaging, interactive game development, graphic arts, web/interactive media design, audio/video production)*;

D3.2 describe the effects of rapidly changing technology on employment opportunities in communications technology;

D3.3 identify professional organizations associated with the various communications technology fields *(e.g., TV, video, and movie production; radio; audio and sound production; print and graphic communications; photography and digital imaging; broadcast journalism; interactive new media)*, and describe their role in professional support and development;

D3.4 explain the need for lifelong learning in the communications technology industry;

D3.5 demonstrate an understanding of and apply the Essential Skills that are important for success in the communications technology industry, as identified in the Ontario Skills Passport *(e.g., reading text, computer use, oral communication, thinking skills)*;

D3.6 demonstrate an understanding of and apply the work habits that are important for success in the communications technology industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability, initiative, customer service, entrepreneurship)*;

D3.7 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in communications technology *(e.g., work logs, skills checklist, photographs, digital media, sketches, drawings)*, and explain why having a current portfolio is important for career development and advancement.

Communications Technology: Digital Imagery and Web Design, Grade 12

Open   **TGJ4O**

This course enables students to develop knowledge and skills in the areas of photography, digital imaging, animation, 3D modelling, and web design. Students will work both independently and as part of a production team to design and produce media products in a project-driven environment. Practical projects may include photo galleries, digital images, animations, 3D models, and websites. Students will also expand their awareness of environmental and societal issues related to communications technology, and will explore postsecondary education, training, and career opportunities.

Prerequisite: None

A. COMMUNICATIONS TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of the core concepts, techniques, and skills required to produce a range of photographic, digital imaging, animation, 3D modelling, and/or web design products or services;

A2. demonstrate an understanding of technical terminology, scientific concepts, and mathematical concepts used in photography, digital imaging, animation, 3D modelling, and/or web design and apply them to the creation of media products;

A3. demonstrate an understanding of and apply the interpersonal skills necessary to work effectively with clients and peers.

SPECIFIC EXPECTATIONS

A1. Core Concepts, Techniques, and Skills

By the end of this course, students will:

A1.1 demonstrate an understanding of technological concepts *(e.g., aesthetics, control, environmental sustainability, ergonomics, fabrication/building/creation, function, innovation, material, mechanism, power and energy, safety, structure, systems)* and their relevance to the design and creation of media projects (see pp. 7–8);

A1.2 use photographic, imaging, and computer equipment safely and correctly to perform basic production tasks or create simple products *(e.g., set up cameras, tripods, and lights; capture images with a digital camera or scanner; transfer images between devices)*;

A1.3 use imaging, image editing, animation, 3D modelling, and web design software correctly to perform basic production tasks or create simple products *(e.g., correcting and manipulating images, preparing images for web or print viewing, tweening, texture mapping, creating an animated GIF, designing a web page)*;

A1.4 demonstrate an understanding of the creative skills and techniques required to produce effective photographs, digital images, animations, 3D models, and/or web pages *(e.g., composition, lighting, image editing and optimization, claymation, site planning)*;

A1.5 identify components of photographic and imaging systems *(e.g., cameras, camera supports and accessories, scanners, computers, monitors, printers)* and devices *(e.g., camera controls, sensor, mirror)*, and describe their functions;

A1.6 use safe and appropriate methods for installing, transporting, and storing photographic and imaging equipment *(e.g., removable storage devices, cameras, cables, flashes, tripods, lights, scanners)*;

A1.7 apply basic design principles *(e.g., balance, rhythm, proportion, contrast, flow)* and elements *(e.g., colour, line, space, form, texture)* to communicate an idea or concept.

A2. Technical Terminology and Scientific and Mathematical Concepts

By the end of this course, students will:

A2.1 demonstrate an understanding of terminology related to photography, digital imaging, animation, 3D modelling, and web design, and use it correctly in oral and written communication *(e.g., resampling, rule of thirds, aperture, resolution, image map, rastor and vector formats, blending, colour mode, key frames, rendering, spline, control points)*;

A2.2 demonstrate an understanding of scientific concepts that relate to processes and technologies used in photography, digital imaging, animation, 3D modelling, and web design *(e.g., behaviour of light, persistence of vision, digital encoding of data, colour temperature, fibre optics, operation of image sensors)*;

A2.3 use mathematical concepts and formulas as required to complete tasks in photography, digital imaging, animation, 3D modelling, and web design *(e.g., f16 rule, file size calculations, image scaling, simulation of effect of gravity on a bouncing ball in an animation, calculation of frame rates)*.

A3. Teamwork

By the end of this course, students will:

A3.1 explain the value of sharing ideas, information, resources, and expertise when working in a team setting;

A3.2 describe and use techniques that encourage participation by all members of a team *(e.g., brainstorming, group discussion, celebration of others' thoughts or contributions)*;

A3.3 describe and use concepts and techniques that facilitate effective collaboration in a team environment *(e.g., cooperative discussion, conflict resolution techniques, motivation techniques, respect for the ideas of others, constructive criticism)*.

B. COMMUNICATIONS TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. use project management techniques effectively in the development of photographic, digital imaging, animation, 3D modelling, and web design products;

B2. apply a design process or other problem-solving processes or strategies to meet a range of challenges in creating photographic, digital imaging, animation, 3D modelling, and web design products;

B3. create productions that demonstrate competence in the application of creative and technical skills.

SPECIFIC EXPECTATIONS

B1. Project Management

By the end of this course, students will:

B1.1 use planning techniques and tools effectively *(e.g., research, storyboards, scripts, site plans, roughs, mock-ups, design briefs)* when creating plans for a photographic, digital imaging, animation, 3D modelling, and/or web design project;

B1.2 use appropriate organizational and time-management tools *(e.g., student planners, journals, production schedules, electronic organizers, organizational software)* throughout the project to ensure that project deadlines are met.

B2. Problem Solving

By the end of this course, students will:

B2.1 apply the steps in a design process to develop solutions to creative challenges *(e.g., define the problem or challenge, taking into account relevant contextual or background information; define project objectives and criteria and identify constraints such as cost, time, or technology limitations; gather information and generate possible solutions using techniques such as brainstorming; evaluate possible solutions and apply the one that most effectively meets the objectives and criteria within the existing constraints)* (see pp. 22–23);

B2.2 apply appropriate problem-solving approaches and/or techniques to solve specific technical problems *(e.g., diagnostics, reverse engineering, trial and error, divide and conquer, parts substitution, extreme cases)*.

B3. Process and Production Skills

By the end of this course, students will:

B3.1 apply creative skills, equipment operating skills, and software skills to create components for a media production *(e.g., create images and animations, design page layout and navigation scheme, edit markup language for a website; shoot photographs, process images, make and mount prints for a photographic exhibition)*;

B3.2 apply editing skills to integrate the components into a unified and effective production.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. describe the environmental impact of communications media technologies, and identify ways of minimizing their harmful effects;

C2. demonstrate an understanding of social effects and issues arising from the use of communications media technologies and the importance of respecting cultural and societal diversity in the production of media projects.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 describe the effects of current photographic, digital imaging, animation, 3D modelling, and web design technologies on the environment *(e.g., paperless publication, increased energy consumption, battery disposal, waste and disposal problems created by rapid obsolescence of equipment)*;

C1.2 describe ways in which environmental problems are being or can be addressed by the photographic, digital imaging, animation, 3D modelling, and web design industries *(e.g., use of rechargeable batteries; reduction of packaging; recycling of paper, toner and ink cartridges; use of energy-efficient equipment; upgrading rather than replacing obsolete equipment; recycling equipment slated for disposal; environmental certification of operations [EcoLogo, ISO 14001])*.

C2. Technology and Society

By the end of this course, students will:

C2.1 demonstrate an understanding of social standards and cultural sensitivity, and use appropriate and inclusive content, images, and language in communications media productions *(e.g., by including people from different races, cultures, and backgrounds in media productions; portraying minority groups with respect and sensitivity; avoiding sexism, homophobia, and cultural or racial bias)*;

C2.2 identify legal and ethical issues applicable to communications media production *(e.g., copyright, respect of privacy and personal information)*;

C2.3 identify recent innovations in photography, digital imaging, animation, 3D modelling, and web design technology *(e.g., replacement of film photography by digital photography, web publication as an alternative to print publication, development of software for performing complex tasks)*, and describe their social and economic effects *(e.g., decline of film manufacturing and related businesses; changes in the professional photography market; new opportunities to reach specialized or mass audiences via the Internet; increased access to information; new ways for individuals and communities to interact socially, to share information, ideas, and creative work, and to influence public opinion; rapid product obsolescence; shifting job opportunities)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and apply safe work practices in the use of photographic, imaging, and computer equipment;

D2. identify careers in photography, digital imaging, animation, 3D modelling, and web design, and describe the skills, work habits, education, and training required for entry into employment in these fields.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 describe industry hazards *(e.g., ergonomic hazards, electrical hazards, mechanical hazards)*, identify sources of hazard information *(e.g., Workplace Hazardous Materials Information System [WHMIS], Passport to Safety)*, and describe methods for preventing accidents;

D1.2 demonstrate an understanding of and apply safe work practices when using equipment *(e.g., use of gloves and other protective clothing, correct seat placement, use of proper cable management techniques, use of ergonomically designed equipment, proper grounding of electrical devices, use of safety chains, correct use of ladders, proper use and storage of equipment)*;

D1.3 describe health risks *(e.g., carpal tunnel syndrome, eye strain)* associated with the use of photographic, imaging, and computer equipment, and identify ways of avoiding them.

D2. Career Opportunities

By the end of this course, students will:

D2.1 identify career opportunities in photography, digital imaging, animation, 3D modelling, and/or web design *(e.g., photographer, animator, web designer)*, and describe the qualifications and skills needed for entry into these occupations;

D2.2 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the photography, digital imaging, animation, 3D modelling, and/or web design industries *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.3 demonstrate an understanding of and apply the Essential Skills that are important for success in the photography, digital imaging, animation, 3D modelling, and/or web design industries, as identified in the Ontario Skills Passport *(e.g., computer use, oral communication, measurement and calculation, numerical estimation, job task planning and organizing, decision making)*;

D2.4 demonstrate an understanding of and apply the work habits that are important for success in the photography, digital imaging, animation, 3D modelling, and/or web design industries, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability, initiative, customer service, entrepreneurship)*;

D2.5 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in photography, digital imaging, animation, 3D modelling, and/or web design *(e.g., work logs, skills checklist, photographs, digital media, sketches, drawings)*, and explain why having a current portfolio is important for career development and advancement.

COMPUTER TECHNOLOGY

Computer technology is an expanding branch of engineering, with roots in both electrical engineering and computer science. It includes the related areas of computer hardware and software; computer interfacing, programming, and networking; analog and digital electronics; and robotics. Computer technicians, technologists, and engineers work in every sector of society, in careers ranging from building and repairing computer systems to designing and installing computer networks, to designing and building prototype robots and electronic devices.

Students taking computer technology courses will learn to work safely with computer equipment, electronic circuits, and robotic devices, and will explore the Essential Skills and work habits that are important for success in computer technology. Computer technology courses prepare students for apprenticeship, further study at college or university, or entry into the workplace directly after graduation.

The list of approved emphasis areas for computer technology can be found at www.edu.gov.on.ca/eng/curriculum/secondary/teched.html.

- Courses in technological education are suitable for use in cooperative education programs and in connection with other forms of experiential learning as well as in programs such as the Specialist High Skills Major (SHSM). For more information, see pages 43–44 of this document.
- For policy guidelines pertaining to multiple-credit courses and emphasis courses, see pages 17–18 of this document.

Computer Engineering Technology, Grade 11

University/College Preparation

TEJ3M

This course examines computer systems and control of external devices. Students will assemble computers and small networks by installing and configuring appropriate hardware and software. Students will develop knowledge and skills in electronics, robotics, programming, and networks, and will build systems that use computer programs and interfaces to control and/or respond to external devices. Students will develop an awareness of related environmental and societal issues, and will learn about college and university programs leading to careers in computer technology.

Prerequisite: None

A. COMPUTER TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. describe how computer components function, and discuss trends in the development of computer hardware;

A2. describe the functions of BIOSes and operating systems, and how they interact with each other and with computer hardware;

A3. describe the function of electronic components and the use of these components in control systems and other circuits, and calculate values for circuit components;

A4. describe network concepts, services, and security;

A5. demonstrate an understanding of the use of binary numbers, hexadecimal numbers, and Boolean algebra in computer logic and data processing.

SPECIFIC EXPECTATIONS

A1. Computer Hardware

By the end of this course, students will:

A1.1 describe how the internal components of a computer function (*e.g., CPU, mainboard, disk drives, RAM, chipset, video card, sound card, expansion slot*);

A1.2 describe various standards for connecting computer components (*e.g., parallel port, RS-232, USB, IEEE 1394, VGA, DVI*);

A1.3 describe trends in the development of computer hardware (*e.g., size, cost, and speed of processors, memory, and hard drives; video resolution; capacity of optical disks*).

A2. Computer Systems

By the end of this course, students will:

A2.1 describe the essential functions and other features of various operating systems (*e.g., **functions:** management of resources, files, processes, and applications; **features:** services, usability, performance, applications such as text editor, web browser, or media player*);

A2.2 describe changes that may be required when upgrading hardware components or features of a computer system (*e.g., BIOS updates, installation of drivers for new hardware, resolution of compatibility issues*);

A2.3 describe the essential functions performed by the BIOS firmware in computer systems (*e.g., POST [power on self test], boot sequence, hardware recognition, detection of master boot record*);

A2.4 describe how the BIOS, hardware, and operating system of a computer interact.

A3. Electronics, Robotics, and Computer Interfacing

By the end of this course, students will:

A3.1 identify and describe the functions of electronic components (*e.g., resistor, capacitor, diode, LED*);

A3.2 describe the function of electrical devices used in control systems (*e.g., stepper motor, direct-current motor, touch sensor, accelerometer, optical sensor, power supply*);

A3.3 calculate the values of components in electronic circuits using fundamental laws (*e.g., Ohm's law, Kirchhoff's laws*);

A3.4 explain the importance of advances in electronics (*e.g., compare size, cost, and performance of vacuum tubes, transistors, and integrated circuits*);

A3.5 compare the advantages and disadvantages of interfacing using desktop computers, micro-controllers, and programmable logic controllers.

A4. Networking Concepts

By the end of this course, students will:

A4.1 explain fundamental network concepts *(e.g., bandwidth, throughput, full duplex, half duplex)*;

A4.2 explain the fundamental aspects of TCP/IP addressing as it pertains to workstations on a network *(e.g., workstation IP address, subnet mask, MAC [media access control] address, default gateway address)*;

A4.3 describe various services offered by servers to network clients *(e.g., HTTP, FTP, SMTP, telnet, printing, file transfers and storage, login)*;

A4.4 describe methods for making a network secure *(e.g., firewalls, data and password encryption, user authentication, WEP or WPA keys, security of server room)*.

A5. Data Representation and Digital Logic

By the end of this course, students will:

A5.1 describe binary and hexadecimal numbers, and convert positive integers among decimal, binary, and hexadecimal number systems;

A5.2 compare binary and hexadecimal representation of addresses and data *(e.g., absolute addressing, character codes, colours)*;

A5.3 relate Boolean algebra to the fundamental logic gates and to combinations of these gates, using symbolic, algebraic, and numeric representations.

B. COMPUTER TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. build, configure, and maintain a computer system, and connect peripheral devices;

B2. set up, optimize, and back up a computer system;

B3. design, construct, create diagrams for, and troubleshoot electronic circuits and interfaces for control systems;

B4. design, install, configure, test, and troubleshoot networks;

B5. demonstrate an understanding of fundamental programming concepts, and develop a program that interacts with an external device.

SPECIFIC EXPECTATIONS

B1. Hardware Solutions

By the end of this course, students will:

B1.1 build a computer from parts to meet specified requirements *(e.g., for gaming, business, entertainment, media centre, or graphic design)*;

B1.2 use correct procedures to prevent damage to sensitive components *(e.g., use anti-static wrist straps and mats, disconnect power when inserting expansion cards)*;

B1.3 install and configure peripheral devices in a computer system *(e.g., printer, video camera, external drives)*;

B1.4 document maintenance and troubleshooting of computer hardware on a day-to-day basis *(e.g., use a journal or log to record work done, time taken, problems found, solutions attempted, and results)*.

B2. Computer Systems

By the end of this course, students will:

B2.1 set up and configure a home office system *(e.g., computer, scanner, printer, appropriate software)*;

B2.2 use system utilities for optimization and backup *(e.g., defragment files; scan hard drives for defective sectors; run complete, incremental, and differential backups)*;

B2.3 configure a computer system to use multiple operating systems *(e.g., dual boot, virtual machines)*.

B3. Electronics, Robotics, and Computer Interfacing

By the end of this course, students will:

B3.1 use a design process (see pp. 22–23) to design and safely construct and test interfacing or robotics circuits *(e.g., for LED traffic lights, VU meter, alarm system, or motor control)*, using appropriate materials and techniques, including soldering;

B3.2 troubleshoot an electronic circuit using appropriate methods and test equipment *(e.g., methods: isolation and substitution of components; equipment: multimeter, oscilloscope, logic probe)*;

B3.3 draw and interpret diagrams that represent circuit components and functions *(e.g., schematic diagram, block diagram, flow chart)*;

B3.4 use computer programs to simulate circuit performance and to draw schematic diagrams and circuit layouts *(e.g., circuit simulator, schematic capture software, printed circuit board layout software)*.

B4. Network Setup and Management

By the end of this course, students will:

B4.1 design, install, and configure a peer-to-peer network *(e.g., choose appropriate computers and network interfaces, construct cables, enable file sharing)* using appropriate tools, materials, and equipment *(e.g., UTP cable, 8P8C connectors, crimping tool, cable tester)*;

B4.2 draw diagrams of various LAN types *(e.g., peer-to-peer, client-server)* and topologies *(e.g., bus, star, ring)*;

B4.3 construct various network cables *(e.g., straight-through, crossover)*;

B4.4 use a variety of methods to verify the operation of a network *(e.g., visual inspection, ping, ipconfig, telnet, tracert, arp)*;

B4.5 use a problem-solving process (see pp. 21–23) to troubleshoot networks.

B5. Computer Programming

By the end of this course, students will:

B5.1 use constants, variables, expressions, and assignment statements correctly, taking into account the order in which operations are performed;

B5.2 use input statements, output statements, selection structures, and repetition structures in a program;

B5.3 use a design process (see pp. 22–23) to write, test, and debug a computer program that controls and/or responds to the inputs from an external device *(e.g., LED array, motor, relay, infrared sensor, temperature sensor)*.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. describe environmental issues related to the widespread use of computers and associated technologies;

C2. describe societal issues related to the widespread use of computers and associated technologies.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 describe the effects of computer and electronic technology on the environment *(e.g., accumulation of electronic waste, including lead and other toxic materials used in computers; release of ozone-destroying chemicals used to wash soldering flux from circuit boards; energy consumed by computers left in standby mode; fuel consumption and air pollution reduced by computerized traffic-control systems)*;

C1.2 outline how community partners and government agencies apply the reduce/reuse/recycle concept to computer technology.

C2. Technology and Society

By the end of this course, students will:

C2.1 describe the benefits of computer and electronic technology for society *(e.g., greater efficiency and lower costs for information services, improved access to technology for economically disadvantaged people and nations, development of a "global village")*;

C2.2 describe some of the drawbacks of computer and electronic technology for society *(e.g., loss of privacy, infringement of intellectual property rights through unlicensed copying and electronic distribution, a more sedentary lifestyle, spam, telemarketing, Internet gambling addictions)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of relevant safety practices, standards, and legislation;

D2. describe ethical and security issues related to the use of computers;

D3. describe various careers related to computer technology and electronics, and the entry requirements for these careers.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 comply with relevant industry practices, standards, and related legislation to ensure workplace safety *(e.g., standards and regulations specified in the Workplace Hazardous Materials Information System [WHMIS] and the Electrical Safety Code; grounding and enclosure standards for electrical circuits; ergonomically sound workplace arrangements and practices)*;

D1.2 describe and use appropriate equipment, techniques, and strategies to avoid health and safety problems associated with computer use *(e.g., back injuries from improper lifting of heavy equipment, repetitive strain injuries, eye strain)*.

D2. Ethics and Security

By the end of this course, students will:

D2.1 describe the components of an acceptable-use policy for computers *(e.g., restrictions on commercial or personal use, prohibition of inappropriate content, protection of privacy)*;

D2.2 explain the importance of and comply with software licensing legislation *(e.g., copyright and patent acts)*;

D2.3 explain the importance of security *(e.g., password protection, encryption)* for confidential data and other sensitive electronic information *(e.g., to protect against industrial espionage or identity theft)*.

D3. Career Opportunities

By the end of this course, students will:

D3.1 describe various careers related to computer technology and electronics that require

postsecondary education *(e.g., computer engineer, systems analyst, network analyst, information technology technician)*;

D3.2 describe entry requirements, including computer expertise, for careers related to computer technology *(e.g., apprenticeships, university programs, college programs, industry certifications)*;

D3.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in computer technology *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D3.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the computer technology industry, as identified in the Ontario Skills Passport (OSP) *(e.g., reading text, writing, document use, computer use, oral communication, numeracy, thinking skills)*;

D3.5 demonstrate an understanding of and apply the work habits that are important for success in the computer technology industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability, organization, working independently, initiative, self-advocacy)*;

D3.6 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in computer technology *(e.g., Passport to Safety certificate, OSP Work Plan, OSP Transition Plan, circuit diagrams, photographs of projects, video of working robot)*, and explain why having a current portfolio is important for career development and advancement.

Computer Technology, Grade 11

Workplace Preparation

TEJ3E

This course enables students to develop knowledge and skills related to computer hardware, networks, operating systems, and other software. Students will use utility and application software, and learn proper procedures for installing, maintaining, and troubleshooting computer systems and networks. Students will develop an awareness of environmental and societal issues related to the use of computers, and will learn about apprenticeships and other employment opportunities in the field of computer technology that they may choose to pursue after graduation.

Prerequisite: None

A. COMPUTER TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. describe the function and development of a variety of computer hardware;

A2. describe the topologies and hardware of computer networks, and the advantages and disadvantages of computer networking;

A3. describe the requirements and purpose of a variety of current software, and identify compatibility issues for this software.

SPECIFIC EXPECTATIONS

A1. Computer Hardware

By the end of this course, students will:

A1.1 use relevant technical terminology to describe computer hardware *(e.g., processors, memory, drives, monitors, printers)*;

A1.2 identify and describe current storage devices *(e.g., hard drives, CD/DVD drives, USB drives)*;

A1.3 describe the function of current input and output devices *(e.g., keyboards, mice, tablets, printers, monitors, scanners, webcams)*;

A1.4 discuss past developments and current trends in hardware technology *(e.g., changes in types, capacity, speed, and cost)*.

A2. Networking Concepts

By the end of this course, students will:

A2.1 describe common network topologies and requirements *(e.g., physical layouts, equipment, connections)*;

A2.2 describe the function of various types of network hardware *(e.g., hubs, switches, routers, cabling)*;

A2.3 describe the advantages and disadvantages of networked computing *(e.g., data sharing, collaborative applications, security, costs, centralized administration, reliability, effects of equipment failure)*.

A3. Software

By the end of this course, students will:

A3.1 describe the purpose of various types of software *(e.g., operating systems, application software, drivers, firmware)*;

A3.2 compare the requirements of various operating systems *(e.g., memory, hard-drive space, processor type and speed, video resolution)*;

A3.3 identify a variety of current software products, their uses, and their hardware requirements;

A3.4 describe the use of drivers and plug-and-play systems for computer hardware;

A3.5 identify issues of software compatibility *(e.g., operating systems; software, driver, and operating system updates; hardware; backward and forward compatibility of files)*.

B. COMPUTER TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. research and determine hardware solutions for users' computer needs;

B2. install, update, maintain, and troubleshoot computer hardware, and back up system and user data;

B3. plan, install, and manage a computer network;

B4. install, use, and update operating systems, utility software, and application software.

SPECIFIC EXPECTATIONS

B1. Hardware Solutions

By the end of this course, students will:

B1.1 analyse user hardware needs for a personal computer (*e.g., processor type and speed, memory, hard-drive capacity, modem and/or network card, video card, audio card, number and types of ports, wireless communication*), and write a summary of these needs;

B1.2 compare availability and costs for hardware from local, national, and/or global suppliers;

B1.3 design an effective home office layout, including the location of computers, peripherals, furniture, and lighting.

B2. Installation, Maintenance, and Troubleshooting

By the end of this course, students will:

B2.1 follow established procedures for installing, servicing, and troubleshooting computer hardware;

B2.2 follow correct procedures to prevent damage to computer components (*e.g., use of anti-static wrist straps, mats, bags, and containers*);

B2.3 perform basic maintenance on the hardware components of a computer system (*e.g., remove dust from fans and circuit boards, clean input devices and monitor screen, change printer cartridges*);

B2.4 use utility software to diagnose and correct problems (*e.g., defragment a drive, scan hard drives for errors and defective sectors, detect and remove viruses and spyware*);

B2.5 use established procedures to perform backups of system data and user information;

B2.6 install and configure expansion and upgrade devices (*e.g., video card, network card, memory, secondary storage devices*).

B3. Network Setup and Management

By the end of this course, students will:

B3.1 use a design process (see pp. 22–23) to plan and install a home or small office network;

B3.2 install and configure additional shared devices on a network (*e.g., printers, scanner, drives*);

B3.3 use network utilities (*e.g., ping, telnet, ipconfig*) to diagnose and correct problems (*e.g., incorrect IP configuration, slow connections*).

B4. Software Implementation

By the end of this course, students will:

B4.1 collect and analyse information from customers to determine their software needs (*e.g., security requirements, budget, applications, preferred platform*);

B4.2 properly set up and configure software for various user needs (*e.g., business, personal, and/or gaming applications; access for multiple users and/or visually impaired users; master user account*);

B4.3 properly install software upgrades (*e.g., operating system, application software*);

B4.4 install and update utility and antivirus software.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. describe environmental issues related to the widespread use of computer technology;

C2. describe societal issues related to the widespread use of computer technology.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 describe the effects of computer technology on the environment (*e.g., accumulation of electronic waste, use of lead and other toxic materials in computers, use of ozone-destroying chemicals to wash soldering flux from circuit boards, energy consumed by computers left in standby mode, energy saved by use of programmable thermostats*);

C1.2 outline how community partners and government agencies apply the reduce/reuse/recycle concept to computer technology.

C2. Technology and Society

By the end of this course, students will:

C2.1 describe the benefits of computer technology for society (*e.g., cheaper and more efficient information services, telecommuting, development of a "global village"*);

C2.2 describe the drawbacks of computer technology for society (*e.g., Internet gambling addictions, more sedentary lifestyle, spam, telemarketing, loss of privacy*).

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. identify and follow computer-related safety practices;

D2. describe ethical and security issues related to the use of computers;

D3. describe and apply professional customer-service practices;

D4. apply the skills required for success in the workplace;

D5. describe opportunities for careers and training related to computer technology.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 use appropriate equipment, techniques, and strategies to avoid health and safety problems when assembling, using, and maintaining computer systems (*e.g., repetitive strain injuries, eye strain, electrical shock*);

D1.2 describe issues related to Internet safety (*e.g., protection of information stored on computers or transmitted over a network, cyberstalking, cyberbullying, privacy policies*).

D2. Ethics and Security

By the end of this course, students will:

D2.1 comply with acceptable-use policies for computers (*e.g., restrictions on commercial or personal use, prohibition of inappropriate content and plagiarism, protection of privacy and intellectual property rights*);

D2.2 explain how copyright legislation applies to computer software and media content, and follow proper licensing and registration procedures for such material (*e.g., **rights:** copyright, open source, public domain; **licences:** shareware, retail, copyleft such as Creative Commons and GNU*);

D2.3 explain the importance of passwords, security software updates, and protection of personal information and client data.

D3. Customer Service

By the end of this course, students will:

D3.1 keep accurate records of customer information using a database, spreadsheet, or word processor (*e.g., customer name, contact information, contact date and time, description of the technical problem and any action taken*);

D3.2 describe the importance of professionalism in customer service (*e.g., telephone etiquette, appropriate personal appearance and demeanour, keeping accurate records*);

D3.3 follow appropriate customer-service protocols and procedures (*e.g., procedures for dealing with complaints, troubleshooting, and customer support by telephone, email, or the Internet*);

D3.4 communicate with clients using an appropriate level of technical terminology.

D4. Workplace Skills

By the end of this course, students will:

D4.1 use time-management skills in project settings (*e.g., set realistic goals, recognize time constraints, plan for deadlines*);

D4.2 use computer terminology correctly, and compile an up-to-date glossary of computer terms and acronyms.

D5. Career Opportunities

By the end of this course, students will:

D5.1 describe various computer-related job opportunities in local business and industry *(e.g., retail sales, apprenticeship, IT hardware technician, IT network technician, electronic service technician)*;

D5.2 identify opportunities for further training and certification *(e.g., apprenticeship, college courses, trade certifications)*;

D5.3 describe lifelong learning methods used in the computer technology industry *(e.g., web-based learning, printed materials, college courses, on-the-job training)*;

D5.4 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in computer technology *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D5.5 demonstrate an understanding of and apply the Essential Skills that are important for success in the computer technology industry, as identified in the Ontario Skills Passport (OSP) *(e.g., reading text, writing, document use, computer use, oral communication, numeracy, thinking skills)*;

D5.6 demonstrate an understanding of and apply the work habits that are important for success in the computer technology industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability, organization, working independently, initiative, self-advocacy, customer service)*;

D5.7 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in computer technology *(e.g., Passport to Safety certificate, OSP Work Plan, OSP Transition Plan, work logs, photographs of projects)*, and explain why having a current portfolio is important for career development and advancement.

Computer Engineering Technology, Grade 12

University/College Preparation

TEJ4M

This course extends students' understanding of computer systems and computer interfacing with external devices. Students will assemble computer systems by installing and configuring appropriate hardware and software, and will learn more about fundamental concepts of electronics, robotics, programming, and networks. Students will examine related environmental and societal issues, and will explore postsecondary pathways leading to careers in computer technology.

Prerequisite: Computer Engineering Technology, Grade 11, University/College Preparation

A. COMPUTER TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of internal buses and storage devices, and of advances in computer technology;

A2. demonstrate an understanding of system optimization and of permissions, attributes, firmware, and communication standards used in computer systems;

A3. demonstrate an understanding of devices and electronic circuits in interfaces and control systems;

A4. demonstrate an understanding of network addressing and routing;

A5. demonstrate an understanding of computer logic circuits and the representation, manipulation, and transmission of data by computers.

SPECIFIC EXPECTATIONS

A1. Computer Hardware

By the end of this course, students will:

A1.1 describe the function of internal buses within computer systems *(e.g., data bus; memory bus; address bus; buses in CPUs, RAM, and chipsets)*;

A1.2 identify appropriate storage devices for various computing requirements *(e.g., optical drives, flash drives, single and arrayed hard drives)*;

A1.3 describe how advances in computer technology *(e.g., CPUs, memory, storage)* have spurred advances in related technologies *(e.g., cellular telephones, hand-held devices, image capture systems)*.

A2. Computer Systems

By the end of this course, students will:

A2.1 describe how to assign permissions and attributes to drives, folders, and files with various operating systems *(e.g., user permissions, archiving, encryption, compression)*;

A2.2 describe methods for optimizing a computer system *(e.g., updating firmware, updating drivers, defragmenting files, allocating virtual memory)*;

A2.3 describe the functions of the BIOS and other firmware in computer systems *(e.g., boot process, hardware recognition, resource allocation, port settings, energy management)*;

A2.4 describe various standards for data flow between computer ports and peripherals *(e.g., MIDI, RS-232, USB, IEEE 1394, SCSI)*.

A3. Electronics, Robotics, and Computer Interfacing

By the end of this course, students will:

A3.1 use technical terminology to accurately describe the specifications for electronic components and computer interfaces;

A3.2 describe the function and operation of various input devices, output devices, and electronic circuits used in interface and control systems *(e.g., **input devices:** temperature sensor, light sensor, position encoder; **output devices:** AC motor, stepper motor; **circuits:** power supply, motor driver)*;

A3.3 calculate the values and operating parameters of electronic components in a circuit, using fundamental laws and circuit-analysis techniques *(e.g., Ohm's law, Kirchhoff's laws, Thévenin and Norton equivalent circuits)*;

A3.4 draw and interpret diagrams that use standard symbols to represent electronic components and the operation of control systems *(e.g., schematic diagram, block diagram, flow chart)*;

A3.5 research and select components based on circuit requirements *(e.g., use Internet searches, manufacturer's data sheets, supplier catalogues, and/or parts database)*.

A4. Networking Concepts

By the end of this course, students will:

A4.1 describe the function of routed protocols *(e.g., IP, IPX)* and routing protocols *(e.g., RIP, OSPF, EIGRP)* in the transmission of data over a network;

A4.2 explain the seven layers of the OSI (open systems interconnection) model and the corresponding network devices;

A4.3 describe IP addressing and subnetting strategies for IP networks *(e.g., borrowing bits, calculating number of subnets and hosts, determining specific subnet address range)*;

A4.4 describe static and dynamic classful public and private addressing and related strategies *(e.g., Class A, Class B, Class C, NAT, PAT, DHCP)*.

A5. Data Representation and Digital Logic

By the end of this course, students will:

A5.1 perform arithmetic operations on positive and negative binary numbers *(e.g., addition, subtraction)* using two's complement representation;

A5.2 use Boolean logic *(e.g., Karnaugh maps)* to design a solution to a logic problem that has multiple inputs and outputs *(e.g., manufacturing process, starting a car)*;

A5.3 use Boolean logic and the laws of Boolean algebra to design, simplify, and build computer logic circuits using logic gates *(e.g., adder circuit, decoder circuit)*;

A5.4 describe the role of flip-flop circuits in the storage and flow of data *(e.g., asynchronous counter, synchronous counter, shift register, memory register)*;

A5.5 describe how computers store and work with different types of data, including numbers, characters, and arrays;

A5.6 explain how analogue quantities can be represented by digital systems *(e.g., analogue-to-digital converter, pulse-width modulation)*.

B. COMPUTER TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. build computer systems and connection media to meet specific requirements, using appropriate procedures, tools, and equipment;

B2. maintain and troubleshoot a variety of computer hardware and software;

B3. design, build, test, and troubleshoot interfaces and other circuits that meet specific design requirements;

B4. design, build, configure, maintain, and troubleshoot networks, and set up various network services for users;

B5. demonstrate an understanding of programming concepts, and create programs that interact with external devices.

SPECIFIC EXPECTATIONS

B1. Hardware Solutions

By the end of this course, students will:

B1.1 select appropriate components and build computer systems that meet specific requirements *(e.g., gaming system, engineering workstation, media centre, control system, home office system)*;

B1.2 select and use appropriate procedures, tools, and diagnostic equipment when assembling computing devices *(e.g., **procedures:** use of anti-static wrist strap and/or mat; **tools:** crimper; **diagnostic equipment:** multimeter, cable tester, oscilloscope)*;

B1.3 construct and test connection media for interfacing a computer with an external device *(e.g., serial cable, parallel cable)*.

B2. Computer Systems

By the end of this course, students will:

B2.1 use a variety of sources to collect information for solving computer problems *(e.g., Internet searches, technical reference materials)*;

B2.2 create a log and/or engineering journal to document work done on computer systems *(e.g., troubleshooting, software updates, hardware installations, maintenance)*;

B2.3 use a logical approach to diagnose and troubleshoot computer hardware and software problems.

B3. Electronics, Robotics, and Computer Interfacing

By the end of this course, students will:

B3.1 use a design process (see pp. 22–23) and appropriate software *(e.g., circuit simulation software, CAD [computer-aided design] software)* to design circuits;

B3.2 construct circuits made from both discrete components and integrated circuits to perform specific functions *(e.g., regulated power supply, electronic dice, audio amplifier, microcontroller-based alarm circuit)*;

B3.3 safely construct electronic circuits for interfacing or robotic applications using appropriate materials, tools, and techniques, including soldering *(e.g., **materials:** breadboard, printed circuit board, etchant, solder; **tools:** soldering iron, etch bath, third hand with magnifier)*;

B3.4 test and troubleshoot electronic circuits, using appropriate methods *(e.g., isolating and substituting components)* and test equipment *(e.g., multimeter, oscilloscope, logic probe)*, and modify the circuits to meet design requirements if necessary.

B4. Network Setup and Management

By the end of this course, students will:

B4.1 design and build a network *(e.g., connection media, interconnection devices, peripherals, server, workstations)* that meets user requirements;

B4.2 optimize and maintain a computer network *(e.g., check performance, accessibility, and security)*;

B4.3 implement various network services for users *(e.g., HTTP, FTP, remote desktop, SMTP, DHCP)*;

B4.4 configure workstations, servers, and/or networked devices *(e.g., create users, assign privileges to folders, set up services, format and partition hard drives)*;

B4.5 apply logical troubleshooting techniques, using data from simulation and/or diagnostic tools *(e.g., simulation software, packet sniffers, cable tester)*.

B5. Computer Programming

By the end of this course, students will:

B5.1 compare low-level and high-level programming languages;

B5.2 apply programming concepts including subroutines, parameter passing, decision and repetition structures, arrays, and character representation;

B5.3 use a design process (see pp. 22–23) to create a program that interacts with a real-world device *(e.g., traffic light, alarm system, robot, joystick)*;

B5.4 write a low-level program that runs on a real or simulated controller device *(e.g., programmable logic controller [PLC], microcontroller, assembler simulator)*.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. analyse environmental issues related to the widespread use of computers and associated technologies, and apply strategies to reduce environmental harm from computer use;

C2. analyse societal issues related to the widespread use of computers and associated technologies.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 assess the effects of computer and electronics technology on the environment (*e.g., hazardous materials contained in computer components, use of energy and other resources, fuel consumption and air pollution reduced by computerized traffic-control systems*);

C1.2 outline and apply strategies to recycle or reuse computers and computer components (*e.g., develop a local recycle/reuse program, create an in-school public awareness campaign*).

C2. Technology and Society

By the end of this course, students will:

C2.1 assess the benefits of computer and electronic technology for society (*e.g., improved access to technology for economically disadvantaged people and nations; greater efficiency and lower costs for information services; development of a "global village"; software that can help monitor or predict changes in wetland area, deforestation, and climate*);

C2.2 assess the drawbacks of computer and electronics technology for society (*e.g., Internet gambling addictions, more sedentary lifestyle, spam, telemarketing, loss of privacy, infringement of intellectual property rights through unlicensed copying and electronic distribution*).

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. explain the importance of safety standards and practices, and use appropriate techniques to avoid health and safety problems;

D2. describe ethical and security issues related to the use of computers and related technology;

D3. assess career opportunities related to computer technology and electronics, and explain the importance of postsecondary education and lifelong learning in the computer technology industry.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 explain the importance of following industry health and safety standards and practices *(e.g., standards and regulations specified in the Workplace Hazardous Materials Information System [WHMIS] and the Electrical Safety Code; practices such as electrical grounding and precautionary measures when working with live circuits and devices that store electrical energy; ergonomically sound workplace arrangements and practices)*;

D1.2 evaluate and use appropriate techniques to avoid health and safety problems *(e.g., repetitive strain injuries, eye strain, electrical shock, burns from soldering tools)* when assembling, using, and maintaining computer systems.

D2. Ethics and Security

By the end of this course, students will:

D2.1 describe the components of an acceptable-use policy for computers, cellular technology, PDAs, and/or other electronic devices *(e.g., appropriate use, protection of intellectual property rights, prohibition of plagiarism)*;

D2.2 outline a purchasing policy for computers, taking ethical issues into account *(e.g., the environment, human rights, child labour)*;

D2.3 describe methods to safeguard confidential data and other sensitive electronic information *(e.g., password protection, encryption, biometrics, behaviometrics, steganography)*.

D3. Career Opportunities

By the end of this course, students will:

D3.1 assess various career opportunities related to computer technology and electronics *(e.g., computer engineering technician or technologist, electrical engineer, programmer, systems analyst)*, and identify opportunities for further training and certification *(e.g., college or university programs, trade certifications)*;

D3.2 explain the need for lifelong learning in the computer technology industry *(e.g., rapid changes in technology, employability, progress into positions of greater responsibility)*;

D3.3 demonstrate an understanding of and apply the Essential Skills that are important for success in the computer technology industry, as identified in the Ontario Skills Passport (OSP) *(e.g., reading text, writing, document use, computer use, oral communication, numeracy, thinking skills)*;

D3.4 demonstrate an understanding of and apply the work habits that are important for success in the computer technology industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability, organization, working independently, initiative, self-advocacy)*;

D3.5 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in computer technology *(e.g., Passport to Safety certificate, OSP Work Plan, OSP Transition Plan, circuit diagrams, photographs of projects, video of working robot)*, and explain why having a current portfolio is important for career development and advancement.

Computer Technology, Grade 12

Workplace Preparation   TEJ4E

This course enables students to further develop their practical understanding of computer hardware, software, networks, and operating systems. Students will use utility and application software, and will follow proper procedures for installing, maintaining, and troubleshooting computer systems and networks. In addition to demonstrating an understanding of the ethical use and environmental effects of computers, students will develop marketable skills and assess career opportunities in the field.

Prerequisite: Computer Technology, Grade 11, Workplace Preparation

A. COMPUTER TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. describe the function and development of a variety of current computer hardware;

A2. describe network topologies, devices, and connection media as well as common user network requirements;

A3. describe various types of software, analyse software needs, and evaluate available software.

SPECIFIC EXPECTATIONS

A1. Computer Hardware

By the end of this course, students will:

A1.1 accurately use relevant technical terminology to describe the specifications of computer hardware (*e.g., type, speed, capacity, compatibility, connections*);

A1.2 describe the characteristics of processor types (*e.g., 32-bit, 64-bit, multi-core*);

A1.3 describe the operation of current input and output devices (*e.g., keyboards, mice, tablets, printers, monitors, scanners, webcams*);

A1.4 describe the evolution of home computing (*e.g., cost, availability, and ease of use of computing systems*);

A1.5 describe hardware innovations in computers and related technologies (*e.g., lower costs, faster speeds, smaller sizes, and greater memory density for computers and for cellular, hand-held, and biometrics devices*);

A1.6 explain the effect of trends in software design and data storage on hardware requirements and data processing (*e.g., the need for increased processor speed, memory, storage capacity, and bandwidth; longer boot times; large increases in the number and size of files*).

A2. Networking Concepts

By the end of this course, students will:

A2.1 research and describe common network topologies and technologies;

A2.2 compare hardware and connection media (*e.g., **hardware:** hub, switch, router; **media:** UTP, fibre-optic cable, wireless*) used for different types of networks (*e.g., home and small office, small-to-medium enterprise*);

A2.3 describe common user requirements that affect the design of a network (*e.g., shared printer, wireless access, shared Internet connection, remote access*).

A3. Software

By the end of this course, students will:

A3.1 describe the purpose and basic operation of an operating system;

A3.2 describe the purpose and basic operation of common application software (*e.g., word processors, spreadsheets, databases, programming environments*);

A3.3 describe the purpose and basic operation of various types of utility software (*e.g., system tools, backup and recovery software, antivirus and anti-spyware programs, security suites*);

A3.4 analyse user software needs for a given purpose;

A3.5 evaluate the suitability of available software for a specific task;

A3.6 describe the specific minimum hardware configurations required for various software.

B. COMPUTER TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. determine and report on hardware solutions for user computing needs;

B2. install, maintain, and troubleshoot computer hardware, and design backup procedures;

B3. install, configure, manage, maintain, and troubleshoot computer networks and related services;

B4. install, configure, and update a variety of software.

SPECIFIC EXPECTATIONS

B1. Hardware Solutions

By the end of this course, students will:

B1.1 use a problem-solving process (see pp. 21–23) to find solutions for user hardware needs, and compare and contrast solutions for various situations *(e.g., home computing, desktop publishing, small business, large office)*;

B1.2 compare hardware availability and costs from local, national, and global suppliers;

B1.3 write a report recommending computing hardware to meet user requirements.

B2. Installation, Maintenance, and Troubleshooting

By the end of this course, students will:

B2.1 develop and follow procedures for hardware installation, service, and troubleshooting;

B2.2 document and follow correct procedures to prevent damage to computer components *(e.g., use of anti-static wrist straps, mats, bags, and containers)*;

B2.3 perform preventive maintenance on a variety of hardware components;

B2.4 use utility software and/or diagnostic tools to correct problems on a computer and/or a network;

B2.5 design effective procedures for backing up system data and user information.

B3. Network Setup and Management

By the end of this course, students will:

B3.1 develop and follow procedures for network installation, service, and troubleshooting;

B3.2 set up and/or configure networked workstations and shared devices using appropriate connection media *(e.g., UTP straight-through and cross-over cables, serial cables, fibre optics, wireless)*;

B3.3 install and configure network operating systems and client services;

B3.4 use network utility software *(e.g., protocol analyser, extended ping, extended traceroute)* to diagnose and correct problems.

B4. Software Implementation

By the end of this course, students will:

B4.1 install and configure new software and upgrades on a computer system;

B4.2 describe the need for software, firmware, and device-driver upgrades, identify various sources for them, and follow proper procedures for installing the various types of upgrades;

B4.3 compare software availability and costs from local, national, and global suppliers;

B4.4 use manuals and online documentation to explore the features of new software.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. describe environmental issues related to the widespread use of computer technology, and apply strategies to reduce environmental harm from computer use;

C2. analyse societal issues related to the widespread use of computer technology.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 assess the effects of computer technology on the environment (*e.g., leakage of hazardous substances from obsolete computers dumped in landfills or improperly recycled; increased energy use; benefits of computer-controlled heating and cooling systems*);

C1.2 outline and apply strategies to recycle and reuse computer components (*e.g., build computers using used components and donate to a community partner, offer a service where computers can be upgraded using used components*);

C1.3 describe and apply strategies and devices that help reduce the energy used by computers at home and in the workplace (*e.g., software that throttles drive speed and CPU speed, monitors that turn off automatically, more efficient processors, lower-speed hard drives, diskless computers, virtualization to eliminate extra computers*).

C2. Technology and Society

By the end of this course, students will:

C2.1 analyse the benefits of computer technology for society (*e.g., improved access to technology for economically disadvantaged people and nations, greater efficiency and lower costs for information services, development of a "global village", use of computers to help monitor and predict long-term environmental changes*);

C2.2 analyse the drawbacks of computer technology for society (*e.g., Internet gambling addictions, more sedentary lifestyle, spam, telemarketing, loss of privacy*).

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. explain and follow computer-related safety standards and practices;

D2. describe ethical and security issues related to the use of computers;

D3. demonstrate an understanding of professional customer-service practices;

D4. apply the skills required for success in the workplace;

D5. describe opportunities for careers and training related to computer technology, and explain the need for lifelong learning in the computer technology industry.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 explain the importance of following industry health and safety standards and practices (*e.g., standards and regulations specified in the Workplace Hazardous Materials Information System [WHMIS], the Electrical Safety Code, and the Occupational Health and Safety Act, and by the Workplace Safety and Insurance Board [WSIB]; ergonomically sound workplace arrangements and practices*);

D1.2 describe and use appropriate equipment, techniques, and strategies to avoid health and safety problems when assembling, using, and maintaining computer systems (*e.g., repetitive strain injuries, eye strain, electrical shock*);

D1.3 research and discuss issues related to Internet safety (*e.g., protection of information stored on computers or transmitted over a network, cyberstalking, cyberbullying, privacy policies*).

D2. Ethics and Security

By the end of this course, students will:

D2.1 describe the components of an acceptable-use policy for computers (*e.g., restrictions on commercial or personal use, prohibition of inappropriate content and plagiarism, protection of privacy and intellectual property rights*);

D2.2 explain the reasons for software licensing agreements and registration procedures;

D2.3 explain the importance of computer security (*e.g., passwords, security software updates, protecting personal identity information and client data*).

D3. Customer Service

By the end of this course, students will:

D3.1 develop procedures for tracking client data electronically (*e.g., using a spreadsheet, database, journal, or log*);

D3.2 explain the importance of professionalism in customer relations (*e.g., ensuring appropriate personal appearance, using active listening techniques, making eye contact, speaking clearly and respectfully, being approachable, being aware and respectful of diverse cultural communication styles*);

D3.3 develop and model customer-service procedures for dealing with clients (*e.g., procedures for complaints, troubleshooting, and providing customer support by telephone, email, or the Internet*);

D3.4 communicate with clients using an appropriate level of technical terminology;

D3.5 model user-level support for software (*e.g., simulate an IT help desk, create an FAQ website*).

D4. Workplace Skills

By the end of this course, students will:

D4.1 demonstrate time-management skills in project settings (*e.g., set realistic goals, recognize time constraints, plan for deadlines, prioritize tasks*);

D4.2 conduct and participate in all aspects of effective meetings for various purposes *(e.g., create and follow an agenda, write and circulate minutes, conduct chaired and round-table meetings)*;

D4.3 use computer terminology correctly, and compile a glossary of computer terms and acronyms.

D5. Career Opportunities

By the end of this course, students will:

D5.1 explore various computer-related job opportunities in local, national, and international businesses and industries *(e.g., retail salesperson, IT hardware technician, IT network technician, electronic service technician)*;

D5.2 describe the opportunities for and the importance of postsecondary training and certification related to computer technology *(e.g., apprenticeship, college courses, trade certifications)*;

D5.3 explain the need for lifelong learning in the computer technology industry;

D5.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the computer technology industry, as identified in the Ontario Skills Passport (OSP) *(e.g., reading text, writing, document use, computer use, oral communication, numeracy, thinking skills)*;

D5.5 demonstrate an understanding of and apply the work habits that are important for success in the computer technology industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability, organization, working independently, initiative, self-advocacy, customer service)*;

D5.6 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in computer technology *(e.g., Passport to Safety certificate, OSP Work Plan, OSP Transition Plan, work logs, photographs of projects)*, and explain why having a current portfolio is important for career development and advancement.

CONSTRUCTION TECHNOLOGY

Construction technology has always played a central role in society. It is a multifaceted industry in which projects can result in products, systems, processes, or services and encompass various aspects of production, repair, and maintenance. In construction technology courses, students will learn about designing, constructing, and maintaining a variety of buildings and structures, and will gain experience with the tools, equipment, and processes commonly used in the field. Students will also learn about health and safety standards in the construction industry, building codes and regulations, and employment opportunities and careers in the various sectors of the industry, including electricity, carpentry, masonry, heating and cooling, and plumbing.

The construction technology courses initially focus on residential and light construction systems related to residential buildings and structures, and progress to more advanced residential and light commercial construction. The woodworking courses allow students to concentrate on furniture building or cabinet making.

The list of approved emphasis areas for construction technology can be found at www.edu.gov.on.ca/eng/curriculum/secondary/teched.html.

- Courses in technological education are suitable for use in cooperative education programs and in connection with other forms of experiential learning as well as in programs such as the Specialist High Skills Major (SHSM). For more information, see pages 43–44 of this document.
- For policy guidelines pertaining to multiple-credit courses and emphasis courses, see pages 17–18 of this document.

Construction Engineering Technology, Grade 11

College Preparation

TCJ3C

This course focuses on the development of knowledge and skills related to residential construction. Students will gain hands-on experience using a variety of construction materials, processes, tools, and equipment; learn about building design and planning construction projects; create and interpret working drawings and sections; and learn how the Ontario Building Code and other regulations and standards apply to construction projects. Students will also develop an awareness of environmental and societal issues related to construction technology, and will explore career opportunities in the field.

Prerequisite: None

A. CONSTRUCTION TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of construction materials, processes, and components;

A2. describe the building codes, regulations, and standards that govern construction projects;

A3. demonstrate an understanding of the systems in a residential building;

A4. demonstrate an understanding of design considerations for residential buildings;

A5. use construction terminology correctly.

SPECIFIC EXPECTATIONS

A1. Materials, Processes, and Components

By the end of this course, students will:

A1.1 identify and describe the uses and features of construction materials *(e.g., lumber, concrete, oriented-strand board [OSB], adhesives, finishes, hardware)*, tools *(e.g., hammers, pliers, hand saws, circular saws, drills)*, and equipment *(e.g., generators, scaffolds)*;

A1.2 identify and describe the properties *(e.g., physical, mechanical, thermal)* of common natural and manufactured building materials *(e.g., natural wood, engineered wood, steel framing)*;

A1.3 identify and describe the processes used to produce a variety of construction materials *(e.g., concrete, masonry, metal products, wood products)*;

A1.4 identify and describe various residential construction processes *(e.g., slip forming, insulated concrete forming, platform framing, balloon framing, assembling modular cabinetry)*;

A1.5 identify and describe structural and non-structural components of buildings *(e.g., structural: footings, foundations, floors, bearing walls, columns, beams, lintels, trusses, rafters; non-structural: trim, siding, flooring)*.

A2. Building Codes, Regulations, and Standards

By the end of this course, students will:

A2.1 describe the purpose of building codes *(e.g., Ontario Building Code, Ontario Electrical Safety Code, Ontario Fire and Plumbing codes)*;

A2.2 identify and describe regulations and/or by-laws that apply to the design and construction of residential buildings *(e.g., municipal by-laws; zoning regulations; official plans; requirements for setbacks, easements, and barrier-free access)*;

A2.3 identify and describe standards that apply to residential construction projects *(e.g., standards from the Canadian Standards Association [CSA], Underwriters Laboratories of Canada [ULC], and the Workplace Safety and Insurance Board [WSIB])*;

A2.4 identify permits and inspections required for residential construction projects *(e.g., building, plumbing, electrical)*;

A2.5 describe how standards for the quality and processing of materials *(e.g., lumber grades, CSA specifications for pipe and wire)* affect the design of a building;

A2.6 identify organizations that promote sustainable building practices, and related standards *(e.g., Canada Green Building Council, Leadership in Energy and Environmental Design [LEED®] certification standards)*.

A3. Building Systems

By the end of this course, students will:

A3.1 identify and describe the systems in a typical building *(e.g., foundation, framing, electrical, plumbing, roof)*;

A3.2 describe the relationship between structural systems and architectural elements in construction *(e.g., cladding on an exterior support pier)*;

A3.3 identify and describe modifications to building systems that would improve the quality and value of the building *(e.g., upgraded ventilation, insulation, air barrier).*

A4. Design Considerations

By the end of this course, students will:

A4.1 describe the features of different types of houses *(e.g., one-storey, two-storey, split-level, duplex)*;

A4.2 identify a variety of building types *(e.g., residential, institutional)*, architectural styles *(e.g., Colonial, Tudor, Victorian, Aboriginal)*, and construction engineering features *(e.g., post and beam, keystone, steel supporting column)*;

A4.3 identify components of an environmentally friendly house *(e.g., solar water heater, energy-efficient heating and cooling systems, recycled building materials)*;

A4.4 describe human factors *(e.g., function, ergonomics, aesthetics)* to consider when planning aspects of a house *(e.g., size, appearance, traffic flow, means of egress, use of non-allergenic materials)*;

A4.5 identify and describe the reasons for selecting a particular structure and materials for a construction project *(e.g., **structure:** wood versus steel beams; **materials:** asphalt shingles versus steel roofing)*;

A4.6 identify factors affecting the design of a foundation *(e.g., drainage, soil type, load, frost penetration)*;

A4.7 identify the weather-related loads and stresses that a building must be designed to withstand *(e.g., force of wind, snow load on roofs, expansion and contraction due to changes in temperature and humidity).*

A5. Terminology

By the end of this course, students will:

A5.1 use correct terminology to identify and describe materials, supplies, and structural components *(e.g., **materials:** plywood, concrete, polyvinyl chloride [PVC] pipe, wire and cable; **supplies:** P-trap, ground fault circuit interrupter; **structural components:** footing, stud, lintel, plenum, valance, gable)*;

A5.2 use correct terminology to describe construction processes and techniques *(e.g., **processes:** joining, levelling, squaring, making plumb; **techniques:** toe-nailing, shimming)*;

A5.3 use correct terminology to identify and describe construction tools and equipment *(e.g., **tools:** framing hammer, level, wire stripper, tri-square, power nailer; **equipment:** air compressor, cement mixer).*

B. DESIGN, LAYOUT, AND PLANNING SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. apply a design process and other problem-solving processes and techniques as appropriate to develop solutions for construction problems or challenges;

B2. create and use working drawings for a variety of residential construction projects;

B3. determine, use, and communicate accurate technical data in the design of construction projects;

B4. use the mathematical skills required in designing, laying out, and preparing estimates for construction projects.

SPECIFIC EXPECTATIONS

B1. Design and Planning

By the end of this course, students will:

B1.1 identify the steps of a design process (see pp. 22–23), and describe how the design process is used in the construction industry (*e.g., preparing floor plans, designing prefabricated components; in urban planning*);

B1.2 use appropriate problem-solving processes and techniques (see pp. 21–23) to address challenges related to various residential construction projects (*e.g., house, cottage, shed, renovation*);

B1.3 use models, prototypes, and/or sketches to aid in improving the design of construction projects;

B1.4 apply design principles (*e.g., scale, proportion, contrast*) when designing systems in construction projects (*e.g., placement of electrical and plumbing fixtures*).

B2. Technical Drawings

By the end of this course, students will:

B2.1 identify the symbols, abbreviations, hatchings, and other conventions used in various types of drawings of residential buildings (*e.g., layout, foundation, floor plan, elevation, cross-section, detail, electrical system, mechanical system*);

B2.2 interpret technical drawings and specifications to accurately plan and lay out residential construction projects (*e.g., determine dimensions,*

materials required, windows and door types, and locations of electrical devices and plumbing fixtures);

B2.3 modify and/or create hand-drafted and/or computer-assisted technical drawings (*e.g., orthographic, isometric, plan, elevation, plumbing, cross-section*), using appropriate metric and/or imperial units.

B3. Using Technical Data

By the end of this course, students will:

B3.1 use appropriate sources to determine the technical requirements for residential construction projects (*e.g., technical charts and tables, engineering reports, building codes and regulations, standards, municipal by-laws*);

B3.2 identify and describe the types of loads (*e.g., live, dead*) that building codes require residential structural members (*e.g., footings, foundations, floors, bearing walls, roofs, columns, beams, lintels*) to withstand;

B3.3 communicate accurate technical information verbally and graphically (*e.g., through written instructions, sketches, and/or detail drawings*).

B4. Mathematical Skills

By the end of this course, students will:

B4.1 determine dimensions and lay out construction projects using mathematical principles and formulas (*e.g., Pythagorean theorem, volume and area formulas*);

B4.2 use the tables in Part 9 of the Ontario Building Code to determine the required sizes, spacing, and numbers of structural components *(e.g., floor joists, lintels)* for a construction project;

B4.3 prepare detailed, accurate estimates of quantities and costs of materials for construction projects, using appropriate metric and/or imperial units *(e.g., metres, square metres, litres, board feet, linear feet, square feet, cubic yards)*;

B4.4 determine lengths and diameters of fastening devices needed to assemble various construction projects *(e.g., lengths and gauges of screws, nails, and staples; diameters of dowels)*, using appropriate metric and/or imperial units.

C. FABRICATION, ASSEMBLY, AND FINISHING SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate appropriate technical skills, including the safe use of construction tools, equipment, and materials;

C2. demonstrate safe and accurate building techniques;

C3. correctly apply various finishes to complete residential construction projects.

SPECIFIC EXPECTATIONS

C1. Technical Skills

By the end of this course, students will:

C1.1 demonstrate safe work practices when using hand tools, power tools, equipment, and materials;

C1.2 correctly use metric and imperial measuring tools and equipment in a variety of construction projects;

C1.3 lay out construction projects using a variety of tools and equipment *(e.g., framing square, laser level, string line, plumb bob)*.

C2. Fabrication and Assembly

By the end of this course, students will:

C2.1 safely construct projects in accordance with the specifications for the project *(e.g., technical drawings, lists of specified materials and fixtures)*;

C2.2 install various systems of a construction project *(e.g., structural, electrical, plumbing, heating/ventilation/air-conditioning, cabinetry)* in accordance with codes, regulations, and standards *(e.g., building code requirements for size and spacing of joists or beams, Ontario Electrical Safety Code requirements for wiring and fixtures)*;

C2.3 describe modifications to improve residential construction projects, and make these modifications where appropriate.

C3. Finishing

By the end of this course, students will:

C3.1 identify and correctly apply appropriate exterior finishing materials *(e.g., siding, stucco, deck stain)*;

C3.2 identify and correctly apply appropriate interior finishing materials *(e.g., paint, wallpaper, trim, casing)*.

D. **TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY**

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of the environmental effects of construction projects, and ways of reducing harmful effects;

D2. describe how society and the construction industry affect each other.

SPECIFIC EXPECTATIONS

D1. Technology and the Environment

By the end of this course, students will:

D1.1 plan projects and processes to minimize waste *(e.g., use efficient cutting patterns, reuse and recycle leftover materials)*;

D1.2 identify and describe environmentally friendly building practices *(e.g., high-efficiency heating and cooling, renewable energy technologies, reuse of grey water, use of materials produced from sustainable resources)*;

D1.3 describe the environmental effects of using natural and manufactured construction materials *(e.g., energy use, release of toxic chemicals, disposal of manufacturing and construction waste, effects on water supply and quality)*;

D1.4 describe ways of reducing and/or managing energy consumption in the home *(e.g., smart meters, energy-efficient lighting, timers, heat-recovery ventilators)*;

D1.5 describe the life cycle of a construction product *(e.g., manufacture; installation; reuse, recycling, or disposal)*.

D2. Technology and Society

By the end of this course, students will:

D2.1 describe the economic and social effects of the construction industry *(e.g., land use, creation of primary and secondary jobs, transportation of equipment and materials; encroachment on Aboriginal lands)*;

D2.2 describe factors affecting the quality of life of the occupants of residential buildings *(e.g., air quality; allergens; access to schools, transit, and health care)*;

D2.3 describe how societal and client needs *(e.g., budget constraints, barrier-free access, energy efficiency, cultural practices)* affect construction projects.

E. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

E1. demonstrate an understanding of and comply with health and safety regulations and practices specific to the construction industry;

E2. describe career opportunities in the construction industry, and the importance of lifelong learning for these careers.

SPECIFIC EXPECTATIONS

E1. Health and Safety

By the end of this course, students will:

E1.1 describe hazards related to construction materials, processes, tools, and equipment *(e.g., toxic or flammable fumes from solvents, paints, varnishes, and gasoline; explosion or burns from propane; lung damage from silica; tripping or falls in unfinished buildings; shock from damaged power tools or electrical equipment)*, and the precautions that should be taken to avoid these hazards;

E1.2 outline and comply with health and safety legislation and practices for the construction industry *(e.g., Workplace Safety and Insurance Board [WSIB] regulations, provincial labour legislation, Ontario Building Code, local by-laws)*;

E1.3 use, handle, and store materials in accordance with Workplace Hazardous Materials Information System (WHMIS) guidelines;

E1.4 describe the rights and responsibilities of employees *(e.g., the right to know, the right to refuse, the right to participate, as outlined in the Occupational Health and Safety Act)*;

E1.5 use protective clothing, gear, and equipment appropriately *(e.g., dust mask, hard hat, safety glasses, safety harness).*

E2. Career Opportunities

By the end of this course, students will:

E2.1 identify careers in construction technology *(e.g., civil or construction engineer, architectural draftsperson, renovation technician or technologist,* indigenous environmental technician, project manager), and describe the education and training required for these careers;

E2.2 describe the importance of lifelong learning for careers in the construction industry;

E2.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the construction industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

E2.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the construction industry, as identified in the Ontario Skills Passport *(e.g., reading text, document use, measurement and calculation)*;

E2.5 demonstrate an understanding of and apply the work habits that are important for success in the construction industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability)*;

E2.6 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in construction technology *(e.g., Passport to Safety certificate, technical drawings, reports, photographs of projects, Ontario Skills Passport Work Plan)*, and explain why having a current portfolio is important for career development and advancement.

Construction Technology, Grade 11

Workplace Preparation   TCJ3E

This course enables students to develop technical knowledge and skills related to carpentry, masonry, electrical systems, heating and cooling, and plumbing for residential construction. Students will gain hands-on experience using a variety of materials, processes, tools, and equipment to design, lay out, and build projects. They will create and read technical drawings, learn construction terminology, interpret building codes and regulations, and apply mathematical skills as they develop construction projects. Students will also develop an awareness of environmental and societal issues related to construction technology, and will explore postsecondary and career opportunities in the field.

Prerequisite: None

A. CONSTRUCTION TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. identify and describe a variety of construction materials, components, and processes;

A2. describe the scope and purpose of building codes, and identify other regulations and standards that apply to construction projects;

A3. use construction terminology correctly;

A4. apply mathematical skills and scientific concepts in the planning and building of a variety of construction projects.

SPECIFIC EXPECTATIONS

A1. Materials, Components, and Processes

By the end of this course, students will:

A1.1 identify building materials used in residential construction *(e.g., natural wood, plywood, engineered wood products such as oriented-strand board [OSB], concrete, brick, adhesives, steel, copper, acrylonitrile butadene styrene [ABS], cross-linked polyethylene [PEX or XLPE], armoured and non-metallic sheathed electrical cable)*;

A1.2 describe the properties *(e.g., physical, mechanical, thermal)* of natural and manufactured building materials *(e.g., wood studs, steel studs, laminated beams, engineered floor joists)*;

A1.3 identify the components of the various systems in a building *(e.g., **structural:** foundation, load-bearing wall, trusses, rafters; **building envelope:** air barrier, insulation, cladding or siding; **electrical:** service panel, conduit, cable, device boxes, fixtures)*;

A1.4 identify the materials and methods used to manufacture various construction components *(e.g., wood studs, baseboard, moulding, steel beams, plastic pipe, armoured cable, windows, doors, paint)*;

A1.5 identify various construction processes *(e.g., framing, casting concrete in place, bricklaying, tiling, installing millwork, insulating)*.

A2. Codes, Regulations, and Standards

By the end of this course, students will:

A2.1 describe the scope and purpose of the regulations *(e.g., for framing members, built-up beams, electrical wiring, potable water piping, and drain, waste, and vent systems)* in the codes that apply to building construction *(e.g., Ontario Building Code, Ontario Electrical Safety Code, Ontario Fire Code)*;

A2.2 identify other regulations that apply to the design of residential buildings *(e.g., municipal by-laws, zoning, official plans, requirements for barrier-free access)*, and describe the process for obtaining construction permits;

A2.3 identify safety standards that apply to construction projects *(e.g., standards from the Occupational Health and Safety Act, the Canadian Standards Association [CSA], and the Technical Standards and Safety Authority)*.

A3. Terminology

By the end of this course, students will:

A3.1 use correct terminology to identify and describe construction materials *(e.g., concrete forms, studs, lintels, ground-fault circuit interrupters, P-traps, plenums, medium-density fibreboard, plywood, cement, mortar)*;

A3.2 use correct terminology to describe construction processes and techniques *(e.g., **processes:** framing, levelling, squaring, making plumb; **techniques:** toe-nailing, shimming)*;

A3.3 use correct terminology to identify and describe construction tools and equipment *(e.g., **tools:** builder's level, framing hammer, wire stripper, pliers, tri-square, trowel, pipe cutter, hand saw, reciprocating saw, masonry saw, circular saw, drill; **equipment:** air compressor, scaffolding, cement mixer, generator, electrical test meter)*;

A3.4 use correct terminology to identify and describe a variety of low-rise residential building styles *(e.g., bungalow, two-storey, townhouse, side-split)*.

A4. Mathematical Skills and Scientific Concepts

By the end of this course, students will:

A4.1 convert between fractions and decimals, and between imperial and metric units *(e.g., between feet and metres, between Fahrenheit and Celsius temperatures)*, using appropriate tables or charts;

A4.2 accurately calculate the layout and materials required for construction tasks *(e.g., layout of open stair stringers, sizes of lintels, loads and wire gauges for electrical circuits, lengths and diameters of drain and vent pipes, duct sizes and lengths for residential heating/cooling systems)*;

A4.3 estimate the quantities and costs of materials for construction projects, using appropriate metric and imperial units *(e.g., metres, square metres, cubic metres, board feet, linear feet, square feet, cubic yards)*, and estimate the labour costs for these projects;

A4.4 determine lengths and diameters of fastening devices needed to assemble various construction projects *(e.g., lengths and gauges of screws, nails, and staples; diameters of dowels)*, using appropriate metric and/or imperial units;

A4.5 demonstrate an understanding of scientific concepts *(e.g., relationships among voltage, current, resistance, and power, and between wire size and current capacity; simple electron theory; methods of heat transfer)* related to construction technology.

B. DESIGN, LAYOUT, AND PLANNING SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. apply a design process and/or other problem-solving processes and techniques as appropriate when planning a variety of residential construction projects, and demonstrate an understanding of factors that affect construction design;

B2. create and use working drawings for a variety of construction projects;

B3. determine the requirements in building codes, regulations, and standards that apply to construction projects, and describe the permit and inspection process;

B4. plan the installation of the systems for a building.

SPECIFIC EXPECTATIONS

B1. Design and Planning

By the end of this course, students will:

B1.1 apply a design process and/or other problem-solving techniques (see pp. 21–23) to address construction technology challenges;

B1.2 use models, prototypes, and/or sketches to aid in improving the design for a project;

B1.3 apply design principles *(e.g., scale, proportion, contrast)* when designing residential construction projects *(e.g., kitchen layout, electrical layout, plumbing layout, mechanical layout, structural member layout)*;

B1.4 identify the weather-related loads and stresses that a building must be designed to withstand *(e.g., force of wind, snow load on roofs, expansion and contraction due to changes in temperature and humidity)*, and describe how these factors affect the planning and design of a construction project;

B1.5 provide rationales for using particular materials for construction projects *(e.g., asphalt shingles versus steel roofing, wood studs versus steel studs, block versus poured concrete, natural wood joists versus engineered joists)*.

B2. Working Drawings

By the end of this course, students will:

B2.1 create sketches and/or technical drawings *(e.g., orthographic, isometric, plan, elevation,* section, detail) of one or more building systems *(e.g., structural, plumbing, electrical)*, using manual and/or computer-assisted methods and appropriate metric and/or imperial units;

B2.2 use working drawings to help plan the sequence of tasks for completing a construction project *(e.g., excavation, footings, foundation walls, framing, sheathing, rough-in of mechanical systems, drywalling, installation of devices and fixtures)*;

B2.3 interpret working drawings to accurately lay out projects *(e.g., determine dimensions and placement of footings, columns, openings, and beams; determine specified materials, size and type of windows and doors, masonry bond pattern, and locations of electrical, mechanical, and plumbing components)*.

B3. Codes, Regulations, and Standards

By the end of this course, students will:

B3.1 identify the types of loads *(e.g., live, dead)* that building codes require residential structural members *(e.g., footings, foundations, floors, bearing walls, roofs, columns, beams, lintels)* to withstand;

B3.2 use various resources to determine the requirements in codes, regulations, and standards that apply to construction projects *(e.g., reference charts and tables; published codes, regulations, and standards; guides and trade manuals; government and association websites)*;

B3.3 describe the permit and inspection process required for various aspects of construction projects *(e.g., building, electrical, plumbing, HVAC)*.

B4. Building Systems

By the end of this course, students will:

B4.1 plan systems for construction projects *(e.g., foundation, framing, roof, electrical, plumbing)*;

B4.2 identify the factors affecting foundation design *(e.g., drainage, soils, frost penetration)*, and allow for these factors when planning and designing a construction project;

B4.3 identify the relationships between structural and decorative elements in construction projects *(e.g., studs, toe plates, and top plates provide secure support for baseboards and mouldings, which cover joints where walls meet floors and ceilings; masonry bond patterns provide strength and an attractive appearance)* and incorporate these relationships into the planning and design of construction projects;

B4.4 recommend modifications to a building project that would improve its quality and value *(e.g., upgrades to insulation, air barrier, or HVAC system to reduce operating costs; use of more attractive or durable fixtures, trim, flooring, or exterior finish)*.

C. FABRICATION, ASSEMBLY, AND FINISHING SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate appropriate technical skills, including the safe use of construction tools, equipment, and materials;

C2. demonstrate safe and accurate techniques for assembling construction projects;

C3. apply various finishes to complete construction projects.

SPECIFIC EXPECTATIONS

C1. Technical Skills

By the end of this course, students will:

C1.1 use, maintain, and store construction tools, equipment, and materials safely and correctly *(e.g., **tools:** builder's level, framing hammer, wire stripper, pliers, tri-square, trowel, pipe cutter, hand saw, reciprocating saw, masonry saw, circular saw, drill; **equipment:** air compressor, scaffolding, cement mixer, generator, electrical test meter; **materials:** lumber, sheet goods, plumbing materials, bricks, wiring)*;

C1.2 lay out construction projects using a variety of tools and equipment *(e.g., framing square, laser level, string line, plumb bob)*;

C1.3 use metric and imperial units correctly during the construction of a variety of projects;

C1.4 communicate construction information verbally and graphically *(e.g., through written instructions, sketches, and/or detail drawings)*.

C2. Building and Assembly

By the end of this course, students will:

C2.1 construct or install components of projects according to working drawings, lists of materials and fixtures, and other design specifications *(e.g., for roof pitch, masonry bond pattern, plumbing and electrical fixtures, tile patterns, mechanical system components, and electrical and structured wiring)*;

C2.2 install, test, and, if necessary, troubleshoot various systems of a construction project *(e.g., electrical, plumbing, heating, masonry)*, ensuring that these systems comply with all applicable codes, regulations, and standards;

C2.3 use a variety of appropriate techniques for levelling, plumbing, bracing, and squaring construction components;

C2.4 implement appropriate solutions for construction problems or challenges.

C3. Finishing

By the end of this course, students will:

C3.1 apply appropriate exterior materials to finish construction projects *(e.g., vinyl or wood siding, fascia, soffits, brick veneer)*;

C3.2 apply appropriate interior materials to finish construction projects *(e.g., paint, tile, trim)*.

D. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of the environmental effects of construction projects, and ways of reducing harmful effects;

D2. demonstrate an understanding of how society and the construction industry affect each other.

SPECIFIC EXPECTATIONS

D1. Technology and the Environment

By the end of this course, students will:

D1.1 compare the efficiency and environmental effects of a variety of energy sources used in residential dwellings *(e.g., solar, ground source, pellets, propane, wood, oil, natural gas, wind)*;

D1.2 plan projects and processes to minimize waste *(e.g., use efficient cutting patterns, reuse and recycle leftover materials)*;

D1.3 identify ways of reducing energy consumption in the home *(e.g., heat recovery ventilator, tankless water heater, timers, energy-efficient lighting)*;

D1.4 identify programs provided by community partners and government agencies to reduce construction waste and to reuse or recycle construction materials *(e.g., drywall, wood, refrigerants)*;

D1.5 research and identify sources and certifications for construction materials that have been manufactured using sustainable practices.

D2. Technology and Society

By the end of this course, students will:

D2.1 identify how societal and client needs *(e.g., budget constraints, barrier-free access, energy efficiency, cultural preferences)* affect construction projects;

D2.2 describe how features of residential buildings *(e.g., halls, atriums, stairs, ramps)* can affect the occupants' quality of life;

D2.3 identify the economic and social effects of the construction industry on a community or region *(e.g., direct and indirect effects on employment, waste disposal, land use, water supply, Aboriginal land claims and traditional hunting)*.

E. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

E1. demonstrate an understanding of and comply with health and safety regulations and practices specific to the construction industry;

E2. describe career opportunities in the construction industry, and explain the importance of lifelong learning in this field.

SPECIFIC EXPECTATIONS

E1. Health and Safety

By the end of this course, students will:

E1.1 identify hazards related to construction materials, processes, tools, and equipment *(e.g., toxic or flammable fumes from solvents, paints, varnishes, and gasoline; explosion or burns from propane; lung damage from silica; tripping or falls in unfinished buildings; shock from damaged power tools or electrical equipment)*, and the precautions that should be taken to avoid these hazards;

E1.2 identify and comply with health and safety legislation and practices for the construction industry *(e.g., Workplace Safety and Insurance Board [WSIB] regulations, provincial labour legislation, Ontario Building Code, local by-laws)*;

E1.3 use, handle, and store materials in accordance with Workplace Hazardous Materials Information System (WHMIS) guidelines;

E1.4 describe the rights and responsibilities of employees *(e.g., the right to know, the right to refuse, the right to participate, as outlined in the Occupational Health and Safety Act)*;

E1.5 use protective clothing, gear, and equipment appropriately *(e.g. dust mask, safety glasses, safety harness)*.

E2. Career Opportunities

By the end of this course, students will:

E2.1 identify careers in the construction industry *(e.g., construction craft worker, labourer, tradesperson, estimator, entrepreneur, interior designer,*

artisan), and describe the education and training required for these careers;

E2.2 explain the importance of lifelong learning for someone choosing a career in the construction industry;

E2.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the construction industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

E2.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the construction industry, as identified in the Ontario Skills Passport *(e.g., finding information, job task planning and organizing, measurement and calculation)*;

E2.5 demonstrate an understanding of and apply the work habits that are important for success in the construction industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability)*;

E2.6 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in construction technology *(e.g., Passport to Safety certificate, technical drawings, reports, photographs of projects, Ontario Skills Passport Work Plan)*, and explain why having a current portfolio is important for career development and advancement.

Custom Woodworking, Grade 11

Workplace Preparation

TWJ3E

This course enables students to develop knowledge and skills related to cabinet making and furniture making. Students will gain practical experience using a variety of the materials, tools, equipment, and joinery techniques associated with custom woodworking. Students will learn to create and interpret technical drawings and will plan, design, and fabricate projects. They will also develop an awareness of environmental and societal issues related to the woodworking industry, and will explore apprenticeships, postsecondary training, and career opportunities in the field that may be pursued directly after graduation.

Prerequisite: None

A. CUSTOM WOODWORKING FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. describe the features and applications of materials and processes used in custom woodworking;

A2. describe woodworking tools, equipment, and techniques, and use them safely;

A3. use correct terminology related to woodworking and the materials, tools, equipment, and processes involved.

SPECIFIC EXPECTATIONS

A1. Materials and Processes

By the end of this course, students will:

A1.1 describe traditional and newer natural and manufactured materials commonly used in custom woodworking projects *(e.g., lumber, adhesives, plywood, particle board, oriented-strand board, medium-density fibreboard)*;

A1.2 identify the different classifications and grades that apply to wood used in woodworking *(e.g., hardwood, softwood, clear, select)*, and describe the properties and flaws of wood in these classifications *(e.g., knots, shrinkage, warpage)*;

A1.3 describe common woodworking processes *(e.g., material breakout, planing, shaping, sanding, finishing)*;

A1.4 describe the various finishing processes and materials used in custom woodworking *(e.g., **processes:** painting, staining, veneering, laminating; **materials:** sealants, stains, varnishes, paints, oils, lacquers, veneers)*.

A2. Tools, Equipment, and Techniques

By the end of this course, students will:

A2.1 describe tools and equipment commonly used in the custom woodworking industry;

A2.2 demonstrate the ability to use, maintain, adjust, and store woodworking tools and equipment correctly and safely *(e.g., hammers, measuring instruments, saws, drills, lathes)*;

A2.3 describe and competently use common layout, measuring, tracing, and assembly methods *(e.g., **layout:** determining and marking circumference, radius, and angles; **assembly:** use of screws, glue, dowels, biscuits, milled joints such as half lap, mortise and tenon, dovetail, and tongue and groove)*.

A3. Terminology

By the end of this course, students will:

A3.1 use correct terminology to identify and describe wood products *(e.g., plywood, veneer, annual rings, kiln-dried lumber, dressed lumber)*;

A3.2 use correct terminology to describe woodworking processes and techniques *(e.g., **processes:** truing, dressing, joining, levelling, squaring; **techniques:** shimming, planing, gluing, nailing)*;

A3.3 use correct terminology to identify and describe woodworking tools and equipment *(e.g., air compressor, brad nailer, tri-square, planer, router, T-bevel)*;

A3.4 use correct terminology to describe the elements of woodworking projects *(e.g., frames, panels, joints, drawers, doors, trim, finishes)*;

A3.5 use correct terminology to identify a variety of cabinet and furniture styles *(e.g., **cabinet:** modular, European, face-frame, custom-built; **furniture:** Victorian, French Provincial, Scandinavian, art deco, mission, Shaker)*.

B. DESIGN, LAYOUT, AND PLANNING SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. apply a design process and/or other problem-solving processes and techniques when planning a variety of woodworking projects, taking into account relevant design principles and safety standards;

B2. produce and interpret sketches and/or working drawings for a variety of woodworking projects;

B3. plan efficient and effective fabrication and assembly of the components of woodworking projects;

B4. apply the mathematical skills required in the design and construction of woodworking projects.

SPECIFIC EXPECTATIONS

B1. Design

By the end of this course, students will:

B1.1 follow the steps of a design process (see pp. 22–23) to plan and develop a variety of woodworking projects *(e.g., kitchen counter, cabinet, entertainment centre, coffee table, desk)*;

B1.2 use appropriate problem-solving processes and techniques (see pp. 21–23) to address challenges related to various woodworking projects;

B1.3 demonstrate how design concepts *(e.g., structure, aesthetics, ergonomics)* affect aspects of woodworking projects *(e.g., floor plans, prefabrication, choice of materials and finishes)*;

B1.4 use appropriate design elements *(e.g., line, shape, direction, space, texture, colour)* and principles *(e.g., balance, scale, proportion, contrast, unity)* to enhance the appearance and functionality of woodworking projects;

B1.5 identify the anthropometric measurements and ergonomic considerations for various projects *(e.g., for the height and width of a chair seat or a desk)*;

B1.6 identify and describe the safety standards that apply to woodworking projects *(e.g., Canadian Standards Association [CSA] standards, Underwriters Laboratories of Canada [ULC] standards)*.

B2. Working Drawings

By the end of this course, students will:

B2.1 identify and use appropriate drafting symbols and drawing conventions in drawings of various cabinetry and furniture projects;

B2.2 produce sketches and/or working drawings *(e.g., orthographic drawings, plans, elevations, details)* by hand and/or with computer-assisted methods, using appropriate metric and/or imperial units;

B2.3 interpret working drawings accurately to produce woodworking projects *(e.g., determine dimensions, materials, and hardware placement)*.

B3. Planning and Preparation

By the end of this course, students will:

B3.1 identify and plan the interrelationship between structural and decorative elements in woodworking *(e.g., design the structure to support the decorative elements securely, use trim to hide joints and fasteners, choose hardware and finishes that suit the shape and material of a cabinet)*;

B3.2 plan the safe construction and installation of components commonly used in woodworking projects *(e.g., make bills of materials, compile cut lists)*;

B3.3 lay out projects using a variety of tools and equipment *(e.g., tape measure, combination square, trammel points)*;

B3.4 describe modifications to a woodworking project that would improve its quality and value (*e.g., using different wood, joints, finishes, or hardware*).

B4. Mathematical Skills

By the end of this course, students will:

B4.1 calculate dimensions for woodworking projects in appropriate metric and/or imperial units;

B4.2 convert between fractions and decimals and between imperial and metric units, using appropriate charts and tables, to determine dimensions and quantities for woodworking projects (*e.g., convert lengths from inches to centimetres, areas from square metres to square feet, and volumes from gallons to litres*);

B4.3 determine lengths and diameters of fastening devices needed to assemble various woodworking projects (*e.g., lengths and gauges of screws, nails, and staples; lengths and diameters of dowels*);

B4.4 apply mathematical concepts and formulas when preparing components of a woodworking project (*e.g., to determine length, circumference, radius, diameter, area, volume, and angles*);

B4.5 prepare estimates of quantities and costs of materials required to complete woodworking projects, using appropriate metric and/or imperial units (*e.g., metres, square metres, litres, board feet, linear feet, square feet*).

C. FABRICATION, ASSEMBLY, AND FINISHING SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. fabricate and assemble custom woodworking projects safely, accurately, and efficiently;

C2. prepare surfaces and apply finishing products, trim, and hardware correctly and safely.

SPECIFIC EXPECTATIONS

C1. Fabrication and Assembly

By the end of this course, students will:

C1.1 identify and follow the appropriate procedures to fabricate project components in a logical and efficient sequence *(e.g., select appropriate materials and tools, follow step-by-step instructions)*;

C1.2 use techniques, tools, and equipment to safely and accurately prepare project materials *(e.g., dress raw lumber; measure, cut, square, and drill stock)*;

C1.3 accurately construct projects in accordance with working drawings and specifications;

C1.4 identify and apply appropriate quality-control measures to ensure precise dimensions and correct assembly *(e.g., accurate measurements and cuts, clean joints, true edges)*;

C1.5 use clamps, fasteners, and adhesives safely and appropriately;

C1.6 assemble joints safely and accurately *(e.g., butt, lap, mitred, dovetail, and rabbet joints)*;

C1.7 correctly install various components of a cabinetry or furniture project *(e.g., drawer slides, shelf supports, hinges, lazy Susan, casters)*.

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C2. Finishing

By the end of this course, students will:

C2.1 prepare surfaces correctly for finish application according to type of material, desired finish, and intended use of the project *(e.g., wood species used, smooth or textured surface, environment in which project will be used)*;

C2.2 select suitable finishes *(e.g., stain, paint, varnish, oil, wax)*, taking into account the type of material to be finished, the function of the finish, and the intended use of the project, and use appropriate methods to apply these finishes correctly *(e.g., brush, spray, roller)*;

C2.3 use appropriate techniques, tools, and equipment correctly and safely to install trim and hardware;

C2.4 select and correctly install appropriate surface materials on counters or furniture *(e.g., laminates, ceramics, butcher block, wood veneer)*.

D. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of the environmental effects of the woodworking industry, and ways of reducing harmful effects;

D2. describe how the woodworking industry and society affect each other.

SPECIFIC EXPECTATIONS

D1. Technology and the Environment

By the end of this course, students will:

D1.1 describe the major effects of the woodworking industry on the environment *(e.g., costs and benefits related to forest management; non-sustainable logging that causes deforestation, destruction of old-growth forests, and/or loss of wilderness habitat for endangered species; water and air pollutants released during the production of manufactured materials; energy required to produce and transport materials for woodworking)*;

D1.2 identify the environmental effects of using and disposing of specific natural and manufactured materials *(e.g., landfill or incineration of woodworking waste; harmful emissions from some types of paints, adhesives, and manufactured materials, which contribute to "sick building syndrome")*;

D1.3 identify ways of reducing environmental harm through the choice of particular materials *(e.g., sustainably produced products, products that have a minimal ecological footprint, non-toxic products)*;

D1.4 plan projects and use materials to minimize waste *(e.g., use efficient cutting patterns, reuse or recycle leftover materials)*;

D1.5 identify various certifications and/or standards for sustainable practices *(e.g., Forest Stewardship Council Canada standards)*.

D2. Technology and Society

By the end of this course, students will:

D2.1 identify the beneficial effects of woodworking for society *(e.g., production of useful and attractive products, enjoyment for hobbyists, therapeutic benefits in senior-citizens' programs)*;

D2.2 describe the economic and cultural effects of the custom woodworking industry *(e.g., creation of jobs within the community, opportunity to preserve and/or apply traditional designs)* on a specific community or population *(e.g., Mennonite, Aboriginal)*;

D2.3 describe how societal needs and client preferences *(e.g., budget restraints; cultural, religious, and environmental choices; ease of use by persons with physical disabilities)* affect custom woodworking projects.

E. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

E1. demonstrate an understanding of health and safety regulations and practices specific to woodworking;

E2. identify career opportunities in custom woodworking, and describe the training required for these careers.

SPECIFIC EXPECTATIONS

E1. Health and Safety

By the end of this course, students will:

E1.1 identify hazards related to the materials, processes, and equipment used for custom woodworking (*e.g., flammable or toxic fumes from solvents, paints, and varnishes; risk of injury from cutting tools*);

E1.2 outline the health and safety legislation, regulations, and standards that apply to the custom woodworking industry (*e.g., Workplace Hazardous Materials Information System [WHMIS], Workplace Safety and Insurance Board [WSIB] regulations, provincial labour legislation, local by-laws*);

E1.3 describe the rights and responsibilities of employees (*e.g., the right to know, the right to refuse, the right to participate, as outlined in the Occupational Health and Safety Act*);

E1.4 demonstrate safe practices related to materials, processes, tools, equipment, and facilities used in woodworking;

E1.5 demonstrate an understanding of when and how to use protective clothing, gear, and equipment (*e.g., ensure proper ventilation and use appropriate protective masks when sanding materials or applying finishes that give off hazardous vapours*).

E2. Career Opportunities

By the end of this course, students will:

E2.1 identify career opportunities in custom woodworking (*e.g., tradesperson, artisan, technician, technologist*), and describe the education and training required for these careers;

E2.2 explain the importance of lifelong learning for someone choosing a career in the custom woodworking industry;

E2.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the custom woodworking industry (*e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations*);

E2.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the custom woodworking industry, as identified in the Ontario Skills Passport (*e.g., reading text, document use, measurement and calculation*);

E2.5 demonstrate an understanding of and apply the work habits that are important for success in the custom woodworking industry, as identified in the Ontario Skills Passport (*e.g., reliability, initiative, customer service*);

E2.6 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in custom woodworking (*e.g., Passport to Safety certificate, technical drawings, reports, photographs, Ontario Skills Passport Work Plan*), and explain why having a current portfolio is important for career development and advancement.

Construction Engineering Technology, Grade 12

College Preparation   TCJ4C

This course enables students to further develop knowledge and skills related to residential construction and to explore light commercial construction. Students will gain hands-on experience using a variety of materials, processes, tools, and equipment, and will learn more about building design and project planning. They will continue to create and interpret construction drawings and will extend their knowledge of construction terminology and of relevant building codes and regulations, as well as health and safety standards and practices. Students will also focus on environmental and societal issues related to construction engineering technology, and will explore career opportunities in the field.

Prerequisite: Construction Engineering Technology, Grade 11, College Preparation

A. CONSTRUCTION TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of natural and manufactured materials, construction processes, and building components;

A2. demonstrate an understanding of building codes, regulations, and standards that govern residential and light commercial construction projects;

A3. demonstrate an understanding of the systems in residential and light commercial buildings;

A4. demonstrate an understanding of design considerations for residential and light commercial buildings;

A5. use construction terminology correctly.

SPECIFIC EXPECTATIONS

A1. Materials, Processes, and Components

By the end of this course, students will:

A1.1 assess the properties *(e.g., physical, mechanical, thermal)* of various natural and manufactured building materials *(e.g., wood studs, steel studs, laminated beams, engineered floor joists)*;

A1.2 compare different building materials and techniques that can be used for the same purpose *(e.g., cement block versus poured concrete for a foundation, wood versus steel doors, digging a trench versus using a pneumatic torpedo to install a water service, nails versus adhesive for attaching panelling)*;

A1.3 describe the various processes used to produce common construction materials and components *(e.g., concrete and masonry products, engineered wood products, doors, windows, trusses)*;

A1.4 compare the processes for constructing common types of foundations and structural supports for a building *(e.g., slip forming, insulated concrete forming, post and beam, platform framing, balloon framing)*;

A1.5 assess various types of structural and non-structural components of a building *(e.g., **structural:** floors, studs, trusses, rafters, engineered floor joists, laminated beams; **non-structural:** trim, stiles, cabinetry, curtain walls, siding)*;

A1.6 describe the relationship between structural and architectural components in a building *(e.g., cladding on a support pier, material concealing a steel beam)*.

A2. Building Codes, Regulations, and Standards

By the end of this course, students will:

A2.1 identify and explain the building codes that apply to residential and light commercial construction *(e.g., Ontario Building Code, Ontario Electrical Safety Code, Ontario Fire Code)*;

A2.2 identify the authorities that regulate residential and light commercial construction *(e.g., municipalities, conservation authorities)*, and explain the pertinent regulations *(e.g., requirements for setbacks, easements, and barrier-free access)*;

A2.3 identify permits and inspections required for residential and light commercial construction projects *(e.g., building, plumbing, electrical)*;

A2.4 identify and describe the standards that apply to residential and light commercial construction projects *(e.g., standards from the Workplace Safety and Insurance Board [WSIB], the Canadian Standards Association [CSA], and Underwriters Laboratories of Canada [ULC])*;

A2.5 describe standards for sustainable building practices *(e.g., Leadership in Energy and Environmental Design [LEED®] certification standards)*.

A3. Building Systems

By the end of this course, students will:

A3.1 describe the foundations of typical residential and light commercial buildings, and outline the requirements of the Ontario Building Code that apply to these foundations;

A3.2 describe the structural systems of typical residential and light commercial buildings, and outline the requirements of the Ontario Building Code that apply to these systems;

A3.3 describe the components of electrical systems of typical residential and light commercial buildings *(e.g., service, circuit-breaker panels, wiring, fixtures)*, and outline the requirements of the Ontario Electrical Safety Code that apply to these systems;

A3.4 describe the components of plumbing systems of typical residential and light commercial buildings *(e.g., water supply, piping, fixtures, sewer or septic tank connection)*, and outline the requirements of the Ontario Building Code (Parts 7 and 8) that apply to these systems;

A3.5 describe heating and cooling systems in typical residential and light commercial buildings *(e.g., forced-air furnace, hot-water boiler, ducts, electrical heating, air conditioning)*, and outline the requirements of the Ontario Building Code (Part 6) that apply to these systems.

A4. Design Considerations

By the end of this course, students will:

A4.1 assess the human factors *(e.g., function, ergonomics, aesthetics)* to consider when planning aspects of a building *(e.g., size, appearance, traffic flow, means of egress, use of non-allergenic materials)*;

A4.2 explain the reasons for selecting a particular structure and materials for a construction project *(e.g., **structure:** wood versus steel beams; **materials:** asphalt or cedar shingles versus steel roofing, siding versus brick)*;

A4.3 describe factors affecting the design of a foundation *(e.g., drainage, soil type, load, frost penetration)*;

A4.4 describe the weather-related loads and stresses that a building must be designed to withstand *(e.g., force of wind, snow load on roofs, expansion and contraction due to changes in temperature and humidity)*;

A4.5 compare various building types *(e.g. residential, light commercial)*, architectural styles *(e.g., Colonial, Tudor, Victorian, Aboriginal)*, and their engineering features *(e.g., engineered floor joists, exposed roof trusses, steel beams, fire barriers)*.

A5. Terminology

By the end of this course, students will:

A5.1 use correct terminology to identify and describe construction components and materials *(e.g., stud, girder, ground-fault circuit interrupter, P-trap, plenum, conduit, armoured cable)*;

A5.2 use correct terminology to identify and describe construction processes and concepts *(e.g., **processes:** dress, rip, crosscut, joint; **concepts:** slope, load, thermal resistance, stability, compression strength)*;

A5.3 use correct terminology to identify and describe construction tools and equipment *(e.g., air compressor, laser level, backhoe, framing hammer, wire stripper, tri-square)*;

A5.4 use correct terminology to identify and describe the documents used for planning, scheduling, and controlling the construction process *(e.g., schedules, contracts, Gantt charts, permits, sub-trade contracts)*.

B. DESIGN, LAYOUT, AND PLANNING SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. apply a design process, other problem-solving techniques, and related concepts and principles, as appropriate, to plan construction projects and develop solutions for construction problems and challenges;

B2. create and interpret drawings of residential and light commercial construction projects;

B3. determine, use, and communicate accurate technical data for construction projects;

B4. plan systems for residential and/or light commercial buildings;

B5. apply the mathematical skills required in designing, laying out, and preparing estimates for residential and light commercial construction projects.

SPECIFIC EXPECTATIONS

B1. Design and Planning

By the end of this course, students will:

B1.1 explain how the design process is used in the construction industry *(e.g., developing floor plans, designing prefabricated buildings; in urban planning)*;

B1.2 use appropriate problem-solving processes and techniques to address challenges related to various residential and light commercial construction projects;

B1.3 apply technological concepts *(e.g., aesthetics, ergonomics, function)* to the design of construction projects *(e.g., shape of staircases, appearance of facades, layout of floors, placement of electrical and plumbing fixtures)*;

B1.4 apply design principles and elements to the design of construction projects *(e.g., principles: scale, proportion, balance, contrast; elements: shape, space, line, texture, colour)*.

B2. Technical Drawings

By the end of this course, students will:

B2.1 interpret technical drawings to accurately plan and lay out residential and light commercial construction projects *(e.g., determine dimensions, materials required, hardware placement, window and door sizes and types, and location of electrical and plumbing fixtures)*;

B2.2 create at least one working drawing of a building system *(e.g., structural, electrical, plumbing, heating/ventilation/air-conditioning)* with manual and/or computer-assisted methods, using appropriate views *(e.g., orthographic, plan, elevation, isometric, 3D, section, detail)* and metric and/or imperial units.

B3. Using Technical Data

By the end of this course, students will:

B3.1 use various resources to determine technical data, code requirements, and standards for construction projects *(e.g., reference charts and tables; reports; published codes, regulations, and standards; guides and trade manuals; manufacturers' instructions; government and association websites)*;

B3.2 describe the building code requirements for forces and stresses due to loads and weather conditions *(e.g., heat, cold, wind, snow, rain)* that structural members *(e.g., footings, foundations, floors, bearing walls, roofs, columns, beams, lintels)* must be designed to withstand;

B3.3 communicate accurate technical information verbally and graphically.

B4. Building Systems

By the end of this course, students will:

B4.1 develop plans for a foundation suitable for the site conditions and building design *(e.g., **site conditions:** hydrostatic pressure, drainage, soils, frost penetration; **design:** type of framing and exterior wall finishes)*;

B4.2 plan the installation of the systems used in typical residential and/or light commercial buildings *(e.g., foundation, framing, electrical, plumbing, heating/ventilation/air-conditioning)*;

B4.3 identify and compare modifications *(e.g., upgraded ventilation, insulation, or air barriers)* that would improve the quality and value of a building project *(e.g., resale value, cost recovery)*.

B5. Mathematical Skills

By the end of this course, students will:

B5.1 calculate dimensions and lay out construction projects using relevant mathematical principles and formulas *(e.g., Pythagorean theorem, volume and area formulas)*;

B5.2 convert between fractions and decimals and between metric and imperial units, using appropriate tables, charts, software, and/or online conversion tools;

B5.3 use the tables in Part 9 of the Ontario Building Code to determine the required sizes, spacing, and number of structural components for construction projects *(e.g., footings, floor joists, wall studs, rafters, beams, columns)*;

B5.4 prepare detailed, accurate estimates of the quantities and costs of materials required for construction projects *(e.g., concrete, aggregate, reinforcing steel, asphalt, lumber, roofing, interior and exterior finishes)*.

C. FABRICATION, ASSEMBLY, AND FINISHING SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate appropriate technical skills, including the safe use of construction tools, equipment, and materials;

C2. demonstrate safe and accurate building techniques;

C3. apply various finishes to complete residential and light commercial construction projects.

SPECIFIC EXPECTATIONS

C1. Technical Skills

By the end of this course, students will:

C1.1 demonstrate safe work practices when using hand and power tools, materials, and equipment;

C1.2 use metric and imperial units correctly to measure and specify materials and components for a variety of construction projects;

C1.3 lay out construction projects using a variety of tools and equipment *(e.g., framing square, laser level, string line, plumb bob).*

C2. Fabrication and Assembly

By the end of this course, students will:

C2.1 construct projects in accordance with design specifications *(e.g., working drawings, lists of specified materials and fixtures);*

C2.2 safely install various systems of a construction project *(e.g., electrical, plumbing, heating/ventilation/ air-conditioning)* in accordance with codes, regulations, and standards *(e.g., Ontario Building Code requirements for joists and beams);*

C2.3 describe and implement appropriate solutions and/or modifications in response to problems encountered in residential and light commercial construction projects.

C3. Finishing

By the end of this course, students will:

C3.1 apply appropriate exterior materials to finish residential and light commercial construction projects *(e.g., siding, brick, stone, exterior doors, windows, metal roofing);*

C3.2 apply appropriate interior materials to finish residential and light commercial construction projects *(e.g., baseboard, wainscoting, crown moulding, interior doors, hardware, built-ins).*

D. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. identify and evaluate measures that can be taken to conserve resources on construction projects;

D2. explain how the construction industry and society affect each other.

SPECIFIC EXPECTATIONS

D1. Technology and the Environment

By the end of this course, students will:

D1.1 plan projects and construction processes to minimize waste *(e.g., use efficient cutting patterns, reuse leftover material)*;

D1.2 describe the costs and benefits of environmentally friendly building practices *(e.g., high-efficiency heating and cooling, renewable energy technologies, reuse of grey water, use of materials produced from sustainable resources)*;

D1.3 compare ways of reducing the environmental footprint of construction projects through the choice of energy sources *(e.g., solar, geothermal, wind)*, building design *(e.g., extra insulation, high-efficiency heating systems, green roof)*, and construction processes *(e.g., use of recycled material, fuel-efficient equipment)*;

D1.4 outline strategies to reduce, reuse, and recycle construction materials, and identify methods for implementing sustainable building practices *(e.g., work with a community partner or government agency, help develop local programs, create a public awareness campaign)*;

D1.5 research and describe strategies for implementing sustainable building practices *(e.g., Canada Green Building Council guidelines, Forest Stewardship Council Canada standards)*.

D2. Technology and Society

By the end of this course, students will:

D2.1 research and assess the economic and social effects of the construction industry *(e.g., creation of primary and secondary jobs, transport of materials, land use, resource management, encroachment on Aboriginal lands)*;

D2.2 describe the factors affecting the quality of life of the occupants of residential and/or light commercial buildings *(e.g., air quality, allergens, carcinogens, aesthetics, access to transit and other services)*;

D2.3 describe how provincial and municipal regulations affect the design and cost of construction projects and influence how the construction industry meets societal needs;

D2.4 identify factors to consider in community planning *(e.g., population density, ecology, culture)*.

E. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

E1. demonstrate an understanding of and comply with health and safety regulations and practices specific to the construction industry;

E2. demonstrate an understanding of careers in the construction industry and the education, training, and workplace skills required for these careers.

SPECIFIC EXPECTATIONS

E1. Health and Safety

By the end of this course, students will:

E1.1 assess hazards related to construction materials, processes, tools, and equipment *(e.g., toxic or flammable fumes from solvents, paints, varnishes, and gasoline; explosion or burns from propane; lung damage from silica; tripping or falls in unfinished buildings; shock from damaged power tools or electrical equipment),* and describe the precautions that should be taken to avoid these hazards;

E1.2 describe and comply with health and safety legislation and practices for the construction industry *(e.g., Workplace Safety and Insurance Board [WSIB] regulations, provincial labour legislation, local by-laws);*

E1.3 use, handle, and store materials in accordance with Workplace Hazardous Materials Information System (WHMIS) guidelines;

E1.4 describe the rights and responsibilities of employees *(e.g., the right to know, the right to refuse, the right to participate, as outlined in the Occupational Health and Safety Act);*

E1.5 demonstrate the understanding of when and how to use appropriate protective clothing, gear, and equipment *(e.g., hard hat, respirator, safety harness).*

E2. Career Opportunities

By the end of this course, students will:

E2.1 describe a variety of careers in the construction industry *(e.g., contractor, architect, engineer, tradesperson, technician, technologist, labourer, project manager),* and identify relevant postsecondary programs and their admission requirements;

E2.2 explain the importance of lifelong learning for careers in the construction industry;

E2.3 demonstrate an understanding of and apply the Essential Skills that are important for success in the construction industry, as identified in the Ontario Skills Passport *(e.g., computer use, data analysis, measurement and calculation);*

E2.4 demonstrate an understanding of and apply the work habits that are important for success in the construction industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, initiative);*

E2.5 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in construction technology *(e.g., Passport to Safety certificate, technical drawings, reports, photographs of projects, Ontario Skills Passport Work Plan and Transition Plan),* and explain why having a current portfolio is important for career development and advancement.

Construction Technology, Grade 12

Workplace Preparation

TCJ4E

This course enables students to further develop technical knowledge and skills related to residential construction and to explore light commercial construction. Students will continue to gain hands-on experience using a variety of materials, processes, tools, and equipment; create and interpret construction drawings; and learn more about building design and project planning. They will expand their knowledge of terminology, codes and regulations, and health and safety standards related to residential and light commercial construction. Students will also expand their awareness of environmental and societal issues related to construction technology, and will explore entrepreneurship and career opportunities in the industry that may be pursued directly after graduation.

Prerequisite: Construction Technology, Grade 11, Workplace Preparation

A. CONSTRUCTION TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. assess the properties and applications of a variety of construction materials, tools, equipment, and processes;

A2. demonstrate an understanding of building codes, regulations, and standards for construction projects;

A3. use construction terminology correctly;

A4. apply mathematical skills and scientific concepts in the planning and building of a variety of construction projects.

SPECIFIC EXPECTATIONS

A1. Materials, Tools, Equipment, and Processes

By the end of this course, students will:

A1.1 determine appropriate building materials, tools, and equipment for various construction projects *(e.g., **materials:** wood products, stone, cultured stone, steel studs, copper wire, cast-iron pipe and fittings, polyvinyl chloride [PVC] pipe and fittings, membranes, adhesives; **tools:** saws, power nailers; **equipment:** cement mixer, air compressor, generator, pressure gauge, CO meter)*;

A1.2 compare the properties *(e.g., mechanical, structural, thermal)* of natural and manufactured building materials;

A1.3 compare the advantages and disadvantages of various structural and non-structural materials in construction projects *(e.g., wood versus steel for studs and beams; asphalt shingles versus steel roofing; cement block versus poured concrete; brick versus vinyl, aluminum, or wood siding)*;

A1.4 describe various processes in residential and/or light commercial construction *(e.g., assembling platform framing, pouring concrete, laying brick or block, setting tile, installing structural or reinforcing steel)*.

A2. Codes, Regulations, and Standards

By the end of this course, students will:

A2.1 correctly identify and interpret the sections of building, electrical, and fire codes that apply to residential and/or light commercial construction projects in Ontario *(e.g., Ontario Building Code sections for built-up beams, mechanical fasteners, renovations, and potable-water, storm-water, and drain/waste/vent systems; Ontario Electrical Safety Code chapters for residential and/or commercial electrical wiring and equipment; Ontario Fire Code regulations for fire barriers, air flow, sprinklers, smoke detectors, and fire alarms)*;

A2.2 describe other regulations that apply to construction projects *(e.g., municipal by-laws, conservation authority restrictions, requirements for barrier-free access)*;

A2.3 describe safety standards and regulations that apply to construction projects *(e.g., standards and/or regulations from the Canadian Standards Association [CSA], Underwriters Laboratories of Canada [ULC], the Workplace Safety and Insurance Board [WSIB], the Technical Standards and Safety Authority, and the Occupational Health and Safety Act)*.

A3. Terminology

By the end of this course, students will:

A3.1 use correct terminology for materials *(e.g., girders, open-web steel joists, plenums, medium-density fibreboard, millwork, bricks, mortar)*;

A3.2 use correct terminology for components and concepts *(e.g., **components:** flying form, vent stack, floor drain, plumbing trap, ground-fault circuit interrupter; **concepts:** wet vent, superheat, flashgas,*

control-circuit hunting, subcooling, safety factor, shear force, tensile strength);

A3.3 use correct terminology to identify and describe construction tools and equipment *(e.g., **tools:** builder's level, framing hammer, wire stripper, pliers, tri-square, trowel, pipe cutter, hand saw, reciprocating saw, masonry saw, circular saw, drill; **equipment:** air compressor, scaffolding, cement mixer, generator, electrical test meter)*;

A3.4 use correct terminology to describe types of residential and/or light commercial buildings *(e.g., **residential:** bungalow, two-storey, townhouse, side-split; **commercial:** office, motel, warehouse, mercantile)*;

A3.5 use correct terminology to describe common engineering features of buildings *(e.g., engineered floor joists, roof trusses, structural steel, fire barriers)*.

A4. Mathematical Skills and Scientific Concepts

By the end of this course, students will:

A4.1 convert between fractions and decimals and between imperial and metric units *(e.g., between feet and metres, between Fahrenheit and Celsius temperatures)*, using appropriate tables, charts, software, and/or online conversion tools;

A4.2 use mathematical concepts and formulas *(e.g., trigonometric functions, Pythagorean theorem)* to lay out construction projects;

A4.3 use the tables in Part 9 of the Ontario Building Code to determine the required sizes, spacings, and numbers of structural members *(e.g., footings, concrete blocks, floor joists, wall studs, rafters, beams, columns)*;

A4.4 prepare detailed estimates of quantities and costs of materials for construction projects *(e.g., concrete, lumber, roofing, millwork, finishes)*, and of labour costs for these projects;

A4.5 perform calculations related to the installation of various building systems *(e.g., **electrical:** calculate conduit fill for conductors of various sizes and types, power in two- and three-wire systems, and required conductor size and overcurrent protection for various loads; **plumbing:** calculate flow rates, 45° and parallel offsets for piping, required size and slopes for drains; **carpentry:** calculate angles and rafter sizes for pitched roofs, and riser, tread, and floor-opening sizes for stairs; **heating and cooling:** calculate output of HVAC systems and heat gain and loss of buildings)*;

A4.6 demonstrate an understanding of scientific concepts related to construction technology *(e.g., relationships among voltage, current, resistance, and power, and between wire size and current capacity; simple electron theory; methods of heat transfer)*.

B. DESIGN, LAYOUT, AND PLANNING SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. apply a design process and/or other problem-solving methods as appropriate when planning a variety of residential and/or light construction projects, and demonstrate an understanding of the design considerations for these projects;

B2. create and interpret working drawings for residential and/or light commercial construction projects;

B3. apply accurate technical data and relevant building codes, regulations, and standards when planning and developing construction projects;

B4. plan and lay out systems for residential and/or light commercial buildings.

SPECIFIC EXPECTATIONS

B1. Design and Planning

By the end of this course, students will:

B1.1 apply the steps of a design process and/or other problem-solving techniques (see pp. 21–23) to solve a variety of construction technology challenges or problems;

B1.2 identify the factors that affect site layout and preparation, and allow for these factors when planning and designing construction projects;

B1.3 compare design considerations for a residential property with those for a light commercial property (*e.g., client needs and budget; location, type, and use of building; connection to utilities; zoning restrictions, codes, regulations, and standards; barrier-free access; aesthetics; energy efficiency*);

B1.4 explain how the design process is used in the construction industry (*e.g., with respect to precast concrete, prefabricated components, interior and exterior finishes*);

B1.5 apply design principles when designing aspects of construction projects (*e.g., kitchen, electrical, mechanical, and plumbing layout; means of egress; customer traffic flow; display space*), and describe how various systems are integrated into the overall design;

B1.6 create and/or modify the design of a system for a construction project (*e.g., water supply and drains, roof structure and membrane, furnace and ductwork, control circuit using relay logic and/or a programmable logic controller*).

B2. Working Drawings

By the end of this course, students will:

B2.1 produce sketches and/or working drawings with manual and/or computer-assisted methods (*e.g., electrical riser diagram, stack elevation drawing, wall section*), using appropriate metric and/or imperial units;

B2.2 use working drawings to help plan the sequence of tasks for completing a construction project (*e.g., excavation, footings, foundation walls, framing, sheathing, rough-in of mechanical systems, drywalling, installation of devices and fixtures*);

B2.3 interpret working drawings to accurately lay out construction projects (*e.g., determine dimensions and placement of footings, columns, openings, and beams; determine specified materials, size and type of windows and doors, masonry bond pattern, and locations of electrical, mechanical, and plumbing components*).

B3. Codes, Regulations, and Standards

By the end of this course, students will:

B3.1 outline the building code requirements for forces and stresses due to loads and weather conditions (*e.g., heat, cold, wind, snow, rain*) that structural members (*e.g., footings, foundations, floors, bearing walls, roofs, columns, beams, lintels*) must be designed to withstand;

B3.2 use various resources to find technical data, code requirements, and standards for construction projects *(e.g., reference charts and tables; reports; published codes, regulations, and standards; guides and trade manuals; manufacturers' instructions; government and association websites);*

B3.3 describe the permit and inspection process required for residential and/or light commercial construction projects *(e.g., for demolition, building, electrical system, plumbing, heating, cooling).*

B4. Building Systems

By the end of this course, students will:

B4.1 identify and describe the factors that affect the design and installation of foundations for construction projects *(e.g., drainage, soil conditions, frost penetration, reinforcement, insulation)*, and allow for these factors when planning and designing a construction project;

B4.2 describe and plan the relationship between structural and decorative elements in construction *(e.g., studs, toe plates, and top plates provide secure support for baseboards and mouldings, which cover joints where walls meet floors and ceilings; masonry bond patterns provide strength and attractive appearance);*

B4.3 research, identify, and recommend modifications to a building project that would improve its quality and value *(e.g., upgrades to insulation, air barrier, or HVAC system that reduce operating costs; use of more attractive or durable fixtures, trim, flooring, or exterior finish).*

C. FABRICATION, ASSEMBLY, AND FINISHING SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. apply appropriate technical skills, including the safe use of the tools, equipment, and materials required to build construction projects;

C2. apply safe and accurate techniques for building construction projects;

C3. complete construction projects by correctly applying finishing materials and installing fixtures and devices.

SPECIFIC EXPECTATIONS

C1. Technical Skills

By the end of this course, students will:

C1.1 use safe work practices with all construction tools, materials, and equipment;

C1.2 lay out construction projects using a variety of tools and equipment *(e.g., framing square, laser level, string line, plumb bob)*;

C1.3 install various systems of residential and/or light commercial construction projects *(e.g., structural, electrical, plumbing, masonry, heating/ ventilation/air-conditioning)* safely and in accordance with codes, regulations, and standards;

C1.4 use metric and imperial units correctly and accurately during the construction of various building systems;

C1.5 use various methods to communicate construction information clearly *(e.g., written instructions, sketches, detail drawings)*.

C2. Building and Assembly

By the end of this course, students will:

C2.1 safely construct residential and/or light commercial projects in accordance with design specifications *(e.g., architect's drawings; engineering specifications; fixtures, trim, cabinetry, flooring, or paint chosen by client or interior designer; manufacturers' installation instructions)*;

C2.2 use appropriate solutions for problems in the construction process, and recognize when modifications require a change order.

C3. Finishing

By the end of this course, students will:

C3.1 apply appropriate exterior materials to finish residential and/or light commercial construction projects *(e.g., curtain walls, foundation coatings, stucco, brick veneer, metal siding)*;

C3.2 apply appropriate interior materials to finish residential and/or light commercial construction projects *(e.g., suspended ceiling, baseboards, window and door casings, mouldings, built-ins, ceramic tiles)*.

D. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of the environmental effects of construction projects, and ways of reducing harmful effects;

D2. demonstrate an understanding of how the construction industry affects society.

SPECIFIC EXPECTATIONS

D1. Technology and the Environment

By the end of this course, students will:

D1.1 assess environmentally friendly alternatives for building systems (*e.g., heating with solar energy, heat pumps, or geothermal systems; reusing grey water; harvesting rainwater; chlorine-free treatment of storm water and sewage*);

D1.2 assess the environmental and health effects of using manufactured construction materials (*e.g., pressure-treated wood, oriented-strand board, medium-density fibreboard, cultured stone*);

D1.3 compare ways of reducing and/or managing energy consumption in homes and businesses (*e.g., smart meters, timers, skylights, heat recovery, energy-efficient lighting*);

D1.4 research and describe strategies for implementing sustainable building practices (*e.g., Canada Green Building Council guidelines, Forest Stewardship Council Canada standards*).

D2. Technology and Society

By the end of this course, students will:

D2.1 identify the economic and social effects of the construction industry (*e.g., waste disposal, land use, labour supply and cost, water supply, local infrastructure*);

D2.2 identify factors to consider in community planning (*e.g., population density, culture, the environment*);

D2.3 assess the societal and cultural impact of construction-related emerging technologies from various perspectives (*e.g., Aboriginal, safety, technical, financial, business*).

E. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

E1. demonstrate an understanding of and comply with health and safety regulations and practices specific to the construction industry;

E2. describe the organization and management of construction companies and the entrepreneurial skills needed to establish a successful construction business;

E3. describe the skills and training required for careers in the construction industry.

SPECIFIC EXPECTATIONS

E1. Health and Safety

By the end of this course, students will:

E1.1 describe hazards related to construction materials, processes, and equipment (*e.g., toxic or flammable fumes from solvents, paints, varnishes, and gasoline; explosion or burns from propane; lung damage from silica; tripping or falls in unfinished buildings; shock from damaged power tools or electrical equipment)*, and the precautions that should be taken to avoid these hazards;

E1.2 describe and comply with health and safety legislation and practices for the construction industry (*e.g., Workplace Safety and Insurance Board [WSIB] regulations, provincial labour legislation, the Ontario Building Code, local by-laws)*;

E1.3 use, handle, and store materials in accordance with Workplace Hazardous Materials Information System (WHMIS) guidelines;

E1.4 describe and follow proper procedures for locking out equipment, and for the set-up, use, and maintenance of trenches, ladders, and scaffolding in accordance with Occupational Health and Safety Act regulations and Construction Safety Association of Ontario guidelines;

E1.5 describe the rights and responsibilities of employees (*e.g., the right to know, the right to refuse, the right to participate, as outlined in the Occupational Health and Safety Act)*;

E1.6 demonstrate an understanding of when and how to use appropriate protective clothing, gear, and equipment (*e.g., hard hat, respirator, safety harness)*.

E2. Construction Business

By the end of this course, students will:

E2.1 describe the organization and management of a typical residential and/or commercial construction company (*e.g., roles of general contractor, builder, subcontractor, renovator, lead hand, shop steward, superintendent, and site manager)*;

E2.2 identify documents commonly used in the planning and management of the construction process (*e.g., schedules, contracts, Gantt charts, permits, subtrade contracts)*;

E2.3 identify the factors to be considered when starting a construction company (*e.g., potential clients, product offered, competition, start-up costs, business plan)*;

E2.4 describe the skills important for success as an entrepreneur (*e.g., creativity, leadership, problem solving, time management, self-motivation, organization)*.

E3. Career Opportunities

By the end of this course, students will:

E3.1 describe career opportunities in the construction industry (*e.g., general contractor, builder, tradesperson, technician, technologist, labourer, estimator, engineer, interior decorator, artisan)*;

E3.2 describe the education and training required for careers in the construction industry (*e.g., apprenticeship, postsecondary courses)*, and list the entrance requirements for these programs;

E3.3 demonstrate an understanding of and apply the Essential Skills that are important for success in the construction industry, as identified in the Ontario Skills Passport *(e.g., decision making, document use, measurement and calculation)*;

E3.4 demonstrate an understanding of and apply the work habits that are important for success in the construction industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, initiative)*;

E3.5 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in construction technology *(e.g., Passport to Safety certificate, technical drawings, reports, photographs of projects, Ontario Skills Passport Work Plan and Transition Plan)*, and explain why having a current portfolio is important for career development and advancement.

Custom Woodworking, Grade 12

Workplace Preparation   TWJ4E

This course enables students to further develop knowledge and skills related to the planning, design, and construction of residential and/or commercial cabinets and furniture. Students will gain further experience in the safe use of common woodworking materials, tools, equipment, finishes, and hardware, and will learn about the entrepreneurial skills needed to establish and operate a custom woodworking business. Students will also expand their awareness of health and safety issues and environmental and societal issues related to woodworking, and will explore career opportunities that may be pursued directly after graduation.

Prerequisite: Custom Woodworking, Grade 11, Workplace Preparation

A. CUSTOM WOODWORKING FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. describe the features and applications of materials and processes used in custom woodworking;

A2. demonstrate an understanding and safe use of tools, equipment, and techniques for custom woodworking;

A3. use correct terminology to describe woodworking materials, tools, equipment, processes, and related concepts.

SPECIFIC EXPECTATIONS

A1. Materials and Processes

By the end of this course, students will:

A1.1 describe the factors that affect the quality and classification of wood (*e.g., harvesting method, cutting, drying, flaws*);

A1.2 describe the factors that should be considered when selecting and purchasing wood products (*e.g., cost, type of project, quality, flaws*);

A1.3 describe various moulding profiles and their applications (*e.g., baseboard, casing, crown moulding*);

A1.4 describe the advantages and drawbacks of manufactured materials used in custom woodworking (*e.g., plywood, particle board, oriented-strand board, plastics, steel, adhesives*);

A1.5 compare the properties (*e.g., strength, stability, appearance*) of natural and manufactured materials that are used for the same function (*e.g., natural wood versus plywood or particleboard, linseed oil versus polyurethane*);

A1.6 demonstrate an understanding of structural and non-structural components of woodworking projects (*e.g., **structural:** rails, stiles, corner braces; **non-structural:** trim, finishes, hardware, lazy Susan*);

A1.7 identify and describe various processes for fabricating components of a woodworking project (*e.g., jointing, laminating, turning, milling*);

A1.8 demonstrate a thorough understanding of various materials and processes used to finish woodworking projects (*e.g., **materials:** sandpaper, stains, oils, varnishes; **processes:** sanding, detailing, brushing, spraying*);

A1.9 describe procedures for mass-producing a product (*e.g., use of patterns, jigs, automated machinery, and/or modular construction*), and describe the advantages and disadvantages of mass production as opposed to custom woodworking (*e.g., quality, cost per unit*).

A2. Tools, Equipment, and Techniques

By the end of this course, students will:

A2.1 demonstrate proficiency in using, maintaining, adjusting, and storing construction tools and equipment safely (*e.g., chisels, planes, measuring instruments, table saws, drills, lathes*);

A2.2 demonstrate proficiency with commonly used measuring, layout, and assembly methods (*e.g., **layout and measuring:** determining and marking circumference, diameter, radius, angles, and rounded corners; **assembly:** fasteners, glues, milled joints*);

A2.3 demonstrate proficiency in the selection and safe application of appropriate clamps, fasteners, and adhesives;

A2.4 demonstrate proficiency in safely and accurately constructing and fitting commonly used joints (*e.g., butt, half lap, mortise and tenon, dovetail, dowel, mitre, rabbet, tongue and groove*).

A3. Terminology

By the end of this course, students will:

A3.1 use correct terminology to identify and describe woodworking materials, tools, equipment, and processes *(e.g., **materials:** adhesives, wood types, fasteners; **tools:** router, mitre saw, biscuit jointer, T-bevel, brad nailer; **equipment:** dust-collection system, spray painting booth, air compressor; **processes:** levelling, squaring, making plumb, joining)*;

A3.2 use correct terminology to identify and describe concepts related to custom woodworking projects *(e.g., aesthetics, ergonomics, environmental stewardship, sustainability)*;

A3.3 use correct terminology to describe the distinguishing features of various cabinet and furniture styles *(e.g., gothic, baroque, early colonial)*.

B. DESIGN, LAYOUT, AND PLANNING SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. apply a design process and other problem-solving processes and techniques when planning a variety of woodworking projects, taking into account design principles, safety standards, and other relevant factors;

B2. prepare and interpret sketches and/or working drawings for a variety of woodworking projects;

B3. plan efficient and effective fabrication and assembly of residential and/or commercial woodworking projects;

B4. apply the mathematical skills required in the design and construction of woodworking projects.

SPECIFIC EXPECTATIONS

B1. Design

By the end of this course, students will:

B1.1 explain the steps of a design process (see pp. 22–23), and apply them to plan and develop a variety of woodworking projects (*e.g., kitchen counter, cabinet, entertainment centre, coffee table, desk*);

B1.2 use appropriate problem-solving processes and techniques (see pp. 21–23) to address challenges that arise in the course of various woodworking projects;

B1.3 demonstrate how the overall design of a project is affected by design concepts and other factors (*e.g., structure, ergonomics, aesthetics, cost and availability of materials, customer needs*);

B1.4 describe how to enhance the appearance and functionality of woodworking projects by using appropriate design elements (*e.g., line, space, texture, colour*) and principles (*e.g., balance, scale, proportion, emphasis, unity, continuity*);

B1.5 explain the reasons for choosing particular materials for various woodworking projects (*e.g., strength, cost, appearance, ease of use, availability, environmental considerations*);

B1.6 apply anthropometric measurements and ergonomic principles to projects (*e.g., for the height and width of a chair seat or a desk*);

B1.7 describe the building codes and regulations that apply to built-in woodworking projects (*e.g., Ontario Building Code [Part 7 – Plumbing and Part 9 – Housing and Small Buildings], fire codes, municipal by-laws*);

B1.8 describe product standards that apply to woodworking projects (*e.g., Canadian Standards Association [CSA], Underwriters Laboratories of Canada [ULC], and National Lumber Grades Authority standards*).

B2. Working Drawings

By the end of this course, students will:

B2.1 prepare and/or modify sketches and working drawings (*e.g., orthographic view, plan, elevation, section, detail drawing*), using manual and/or computer-assisted methods and appropriate metric and/or imperial units;

B2.2 interpret a variety of working drawings accurately to produce woodworking projects (*e.g., determine dimensions, materials, and hardware placement*).

B3. Planning and Preparation

By the end of this course, students will:

B3.1 plan and describe the interrelationship of structural and decorative elements in woodworking projects (*e.g., choose structural and finish materials that will bond to each other; choose hardware that suits the shape and style of the design*);

B3.2 create a materials list itemizing all materials and components for a woodworking project;

B3.3 plan and prepare for installation of various components used in woodworking projects *(e.g., make a work schedule and list of tools required, check stock on hand, order materials)*;

B3.4 plan an efficient sequence for fabricating components for a project *(e.g., use appropriate tools and techniques, do operations such as cutting and drilling in batches to reduce set-up time)*;

B3.5 lay out projects using a variety of measurement tools and equipment *(e.g., laser level, tape measure, ruler, scale, protractor)*;

B3.6 describe and, where appropriate, make modifications to woodworking projects to improve the quality and value of the project *(e.g., choose different materials, hardware, finishes, or methods of construction and assembly)*.

B4. Mathematical Skills

By the end of this course, students will:

B4.1 calculate dimensions for woodworking projects in appropriate metric and/or imperial units;

B4.2 convert between fractions and decimals and between imperial and metric units, using appropriate charts, tables, software, and/or online conversion tools, to determine dimensions and quantities for woodworking projects *(e.g., convert lengths from inches to centimetres, areas from square metres to square feet, and volumes from gallons to litres)*;

B4.3 apply mathematical concepts and formulas *(e.g., Pythagorean theorem, volume and area formulas)* when preparing components of a woodworking project;

B4.4 determine lengths, diameters, and quantities of fastening devices needed to assemble various woodworking projects *(e.g., lengths and gauges of screws, nails, and staples; diameters of dowels)*;

B4.5 prepare detailed, accurate estimates of quantities and costs of materials for woodworking projects *(e.g., lumber, hardware, finishes)*, and of labour costs for these projects.

C. FABRICATION, ASSEMBLY, AND FINISHING SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. fabricate and assemble residential and/or commercial custom woodworking projects safely, accurately, and efficiently;

C2. prepare surfaces and apply finishing products, trim, and hardware correctly and safely.

SPECIFIC EXPECTATIONS

C1. Fabrication and Assembly

By the end of this course, students will:

C1.1 apply techniques for using tools and materials safely and efficiently to reduce the cost of producing components that meet the required specifications (*e.g., follow proper procedures for operating machine tools; use stops, guides, or jigs when making sets of identical parts*);

C1.2 use tools, equipment, and techniques to safely and accurately prepare project materials (*e.g., dress raw lumber; measure, cut, square, and drill stock*);

C1.3 program a computer numerically controlled (CNC) machine to fabricate components for a woodworking project;

C1.4 develop and apply appropriate quality-control measures to ensure precise dimensions and correct assembly (*e.g., accurate measurements and cuts, clean joints, true edges*);

C1.5 install various components of a woodworking project in accordance with applicable codes, regulations, and standards.

C2. Finishing

By the end of this course, students will:

C2.1 demonstrate a thorough understanding of how to prepare surfaces for finishes given the type of material, the desired finish, and the intended use of the project;

C2.2 use appropriate tools, equipment, and techniques correctly and safely to install trim and hardware (*e.g., baseboards, hinges, pulls, casters*);

C2.3 select suitable finishes (*e.g., stain, paint, varnish, oil, wax*), taking into account the type of material to be finished, the function of the finish, and the intended use of the project, and use appropriate methods to apply these finishes correctly (*e.g., brush, spray, roller*);

C2.4 select and correctly install appropriate surface materials (*e.g., laminates, ceramics, butcher block, wood veneer*) on a variety of counters and/or furniture.

D. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of the environmental effects of the woodworking industry, and ways of reducing harmful effects;

D2. demonstrate an understanding of how the woodworking industry and society affect each other.

SPECIFIC EXPECTATIONS

D1. Technology and the Environment

By the end of this course, students will:

D1.1 describe ways to improve air quality in a living or working space through the choice of materials for woodworking projects *(e.g., lumber, plastics, medium-density fibreboard, paint, varnish)*;

D1.2 assess the environmental effects of using scarce and/or exotic woods *(e.g., destruction of rainforest and old-growth boreal forests, displacement of Aboriginal peoples, loss of wildlife habitat)* and the extent to which sustainable forestry practices can reduce environmental degradation;

D1.3 plan projects and apply strategies to minimize or mitigate degradation of the environment *(e.g., use efficient cutting patterns, reuse and recycle leftover materials, select sustainably produced products, contribute to restoration plans, purchase carbon offsets)*;

D1.4 assess various certifications and/or standards used to recognize sustainable practices *(e.g., Forest Stewardship Council Canada standards)*.

D2. Technology and Society

By the end of this course, students will:

D2.1 assess how consumer trends and technological innovations have affected employment in the custom woodworking industry *(e.g., use of exotic or old-growth woods, sale of prefabricated furniture and cabinets in large retail outlets, use of computer assisted design [CAD] and CNC machines)*;

D2.2 assess economic and societal issues related to the custom woodworking industry *(e.g., waste disposal, labour supply, logging near Aboriginal communities, imports and exports, use of renewable and non-renewable resources)*.

E. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

E1. explain and follow health and safety regulations and practices specific to woodworking;

E2. describe the knowledge and skills important for success in a custom woodworking business;

E3. demonstrate an understanding of careers in the custom woodworking industry, and the skills, education, and training required for these careers.

SPECIFIC EXPECTATIONS

E1. Health and Safety

By the end of this course, students will:

E1.1 describe hazards related to woodworking materials, processes, tools, and equipment (*e.g., flammable or toxic fumes from solvents, paints, and varnishes; risk of injury from tools and equipment*);

E1.2 describe an understanding of health and safety legislation, regulations, and standards that apply to the custom woodworking industry (*e.g., Workplace Hazardous Materials Information System [WHMIS], Workplace Safety and Insurance Board [WSIB] regulations, provincial labour legislation, Ontario Building Code, local by-laws*);

E1.3 understand the rights and responsibilities of employees (*e.g., the right to know, the right to refuse, the right to participate, as outlined in the Occupational Health and Safety Act*);

E1.4 demonstrate safe practices when using woodworking materials, processes, tools, equipment, and facilities;

E1.5 demonstrate an understanding of how to select and use appropriate protective clothing, gear, and equipment (*e.g., dust mask, respirator, safety glasses, goggles, ventilation system*).

E2. Custom Woodworking Business

By the end of this course, students will:

E2.1 describe the skills important for success as an entrepreneur in the custom woodworking industry (*e.g., communication, organization, creativity, problem solving*);

E2.2 describe the factors that should be considered when starting and/or operating a custom woodworking business (*e.g., potential market, products, competition, financing, business plan*);

E2.3 identify and compare the organization and management of unionized and non-unionized custom woodworking companies (*e.g., role of lead hand, shop steward, and contractor*);

E2.4 identify various types of business structures (*e.g., sole proprietorship, partnership, limited company*).

E3. Career Opportunities

By the end of this course, students will:

E3.1 describe careers in the custom woodworking industry (*e.g., designer, trim carpenter, cabinetmaker, artisan, industrial woodworker, technician, technologist*);

E3.2 describe the education and training required for careers in custom woodworking (*e.g., apprenticeship, postsecondary programs*);

E3.3 explain the importance of lifelong learning for someone choosing a career in the custom woodworking industry;

E3.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the custom woodworking industry, as identified in the Ontario Skills Passport (*e.g., reading text, document use, measurement and calculation*);

E3.5 demonstrate an understanding of and apply the work habits that are important for success in the custom woodworking industry, as identified in the Ontario Skills Passport *(e.g., teamwork, customer service, entrepreneurship)*;

E3.6 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in custom woodworking *(e.g., Passport to Safety certificate, technical drawings, reports, photographs of completed projects, Ontario Skills Passport Work Plan and Transition Plan)*, and explain why having a current portfolio is important for career development and advancement.

GREEN INDUSTRIES

Green industries courses offer students opportunities to investigate how to care for and sustainably manage our natural and living resources. Students will explore a variety of areas within green industries, including agriculture, floristry, forestry, horticulture, and/or landscaping.

Students will gain practical skills and knowledge by completing a variety of authentic, industry-relevant activities and projects, such as plant propagation and greenhouse maintenance activities; landscape design and planning exercises; assignments that include farm or forestry management plans; and various construction projects. In addition, students will be introduced to concepts pertaining to biodiversity, environmental sustainability, and natural versus artificial products. Students will also investigate the numerous and varied ways in which green industries and society are interdependent.

Green industries courses will prepare students for working safely in the many fields that are encompassed in this subject area. Students will learn about career opportunities in the green industries and about the Essential Skills and work habits that are important for success in these fields.

The list of approved emphasis areas for green industries can be found at www.edu.gov.on.ca/eng/curriculum/secondary/teched.html.

- Courses in technological education are suitable for use in cooperative education programs and in connection with other forms of experiential learning as well as in programs such as the Specialist High Skills Major (SHSM). For more information, see pages 43–44 of this document.
- For policy guidelines pertaining to multiple-credit courses and emphasis courses, see pages 17–18 of this document.

Green Industries, Grade 11

University/College Preparation   THJ3M

This course enables students to develop knowledge and skills related to agriculture, forestry, horticulture, and landscaping. Students will study the identification, growth, and management of plants and animals and develop process, design, and management skills required in the green industries. Students will also examine social and economic issues related to the green industries, learn about safe and healthy working practices, study industry standards and codes, and will explore postsecondary education programs and career opportunities.

Prerequisite: None

A. GREEN INDUSTRY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of species classification and identification and relationships between species and geographical regions;

A2. demonstrate an understanding of the effects of biotic and abiotic factors on growth and product quality;

A3. develop and evaluate designs or processes for a variety of applications related to the green industries;

A4. use mathematical, documentation, research, and communication skills as they apply to the green industries.

SPECIFIC EXPECTATIONS

A1. Species Classification and Geographical Regions

By the end of this course, students will:

A1.1 distinguish between different plant and/or animal groups on the basis of key identification characteristics, and identify species using both common names and scientific classifications *(e.g., annuals and perennials; native and non-native plants; major types, species, and varieties of trees, shrubs, flowering plants, and crops; animal breeds)*;

A1.2 identify geographical regions on the basis of classification criteria relevant to the green industries *(e.g., forest type, hardiness, agricultural use, ease of cultivation, water features)*;

A1.3 explain the relationships between the characteristics of different geographical regions and the key desirable characteristics of plant and/or animal groups within them *(e.g., relationship of plant and animal characteristics to available heat, moisture, light, shelter, and food)*.

A2. Factors Affecting Growth and Product Quality

By the end of this course, students will:

A2.1 describe how abiotic factors *(e.g., air quality, temperature, nutrients, water, topography, handling procedures)* affect the growth of various plant and/or animal species and the quality of products derived from them;

A2.2 explain biological processes that are essential to the propagation, development, and health of plants and/or animals and the quality of products derived from them *(e.g., reproduction, respiration, photosynthesis, transpiration, post-harvest physiology)*;

A2.3 identify a variety of pests and diseases *(e.g., bacteria, viruses, moulds, fungi, insects, animals)* and explain their effects on the health of plants and/or animals and the quality of products derived from them.

A3. Designs and Processes

By the end of this course, students will:

A3.1 demonstrate an understanding of and apply the steps in a design process (see pp. 22–23) to a variety of requirements in the green industries *(e.g., creation of forest management plans, environmental farm plans, urban landscape designs, hydroponic system designs)*;

A3.2 explain fundamental operational processes that are commonly used in the green industries *(e.g., single animal management, crop location and rotation, crop scheduling, event planning, nutrient and waste management, composting, select cutting, timber cruise)*;

A3.3 identify a variety of structures used in the green industries *(e.g., mills, barns, different greenhouse styles, store layouts)*, and explain how their structural features relate to their functions;

A3.4 demonstrate an understanding of correct procedures for the care and handling of plants and/or animals *(e.g., propagating, pruning, transporting, watering, feeding, fertilizing, removing bark)*.

A4. Technological and Mathematical Literacy and Communication Skills

By the end of this course, students will:

A4.1 demonstrate an understanding of terminology used in the green industries and use it correctly in oral and written communication *(e.g., sustainability, coniferous, massing flower, flagstone, organic)*;

A4.2 use effective documentation practices to record and track important information related to green industry operations *(e.g., preparing invoices, recording fertilizer and pesticide use, completing maintenance records, maintaining crop management records, documenting Hazard Analysis and Critical Control Point [HACCP] activities)*;

A4.3 describe commercial and technical issues of current significance in the green industries *(e.g., adoption of innovative technologies, marketing boards versus open markets, food safety testing)*, using information from industry sources *(e.g., trade publications and websites, marketing boards, growers' associations)*;

A4.4 perform metric and imperial unit conversions and other calculations as required for a variety of green industry applications *(e.g., land areas, yields, green log weights, diet analyses, invoices)*.

B. GREEN INDUSTRY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. demonstrate an understanding of and apply design and production practices that are commonly used in the green industries;

B2. apply management strategies for assessing and controlling biotic and abiotic factors that affect plant and/or animal quality;

B3. demonstrate competence in technical skills related to specific applications and tasks within the green industries.

SPECIFIC EXPECTATIONS

B1. Design and Production

By the end of this course, students will:

B1.1 implement a production process or procedures according to a design or plan *(e.g., timber cruise, stand inventory, landscape construction, crop rotation, mixed animal farming, selective breeding)*;

B1.2 utilize a management plan for a specific application related to the green industries *(e.g., forest management plan, nutrient management plan, site layout plan, crop rotation plan, annual work plan, business plan, five-year operational plan)*;

B1.3 demonstrate an understanding of and apply techniques related to the propagation and maintenance of a variety of plant and/or animal species and the post-harvest handling of plant products *(e.g., techniques related to crop, mammal, and poultry production, sexual and asexual plant production, shrub rejuvenation, rose processing, care of selected local tree species)*;

B1.4 demonstrate an understanding of and apply techniques or processes that promote biodiversity, increase ecosystem function, and reduce maintenance requirements *(e.g., planting native species, mulching, establishing natural habitat)*;

B1.5 demonstrate an understanding of and apply marketing techniques that are commonly used in the green industries *(e.g., product displays, flyer and poster advertising, Internet sales)*.

B2. Plant and Animal Management Strategies

By the end of this course, students will:

B2.1 apply a variety of methods to monitor and assess biotic factors that affect plant and/or animal quality *(e.g., weed identification, regular animal health inspections, plant quality inspections, pest scouting, post-harvest tracking of product freshness and quality)*;

B2.2 apply a variety of methods to monitor and assess abiotic factors that affect plant and/or animal quality *(e.g., nutrient balance analysis, soil testing, plant tissue analysis, monitoring growing degree days [GDDs], form defect analysis, water testing)*;

B2.3 apply a variety of techniques to control pests and reduce plant and/or animal defects *(e.g., maintenance or enhancement of natural barriers to control pest migration, animal quarantine, log hydration, integrated pest management)*.

B3. Technical Skills

By the end of this course, students will:

B3.1 demonstrate competence in the technical skills required to complete a variety of tasks in the green industries *(e.g., operating power tools and machinery, rigging loads, hardscaping, pesticide application)*;

B3.2 construct a variety of structures or products that are used or produced in the green industries *(e.g., trellises, scaffolds, containers, raised beds, fences)*;

B3.3 demonstrate competence in related technical skills *(e.g., using GPS equipment, welding, wiring and making electrical repairs, operating and maintaining small engines, making orthographic drawings, using computer applications)* that are required to complete a variety of green industry projects.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. analyse the impact of the green industries on the environment and describe ways of minimizing harmful effects;

C2. analyse social and economic relationships and issues involving the green industries.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 demonstrate an understanding of ecological relationships and processes *(e.g., food webs, symbiotic relationships, ecological succession, nutrient flows and cycles, habitat and species diversity)* that can affect or be affected by green industry operations;

C1.2 analyse the effects of green industry activities on the environment in the past and in the present *(e.g., logging practices, irrigation, fertilization, pest control, nutrient and waste management)*;

C1.3 assess the advantages and disadvantages of using natural rather than manufactured materials or products in green industry activities *(e.g., natural fertilizers and pest control methods rather than chemical fertilizers and pesticides, real flowers rather than artificial flowers, real grass rather than artificial turf, untreated rather than pressure-treated lumber)*;

C1.4 identify sustainable practices and guidelines that are currently applied within the green industries or may be applied in the future *(e.g., environmental farm planning, integrated pest management, xeriscaping, forest regeneration, low-till cultivation)*;

C1.5 explain the environmental implications *(e.g., effects on landfill lifespan and water and air quality)* of using particular materials, products, processes, and disposal methods *(e.g., recycling, reusing, composting, growing genetically modified crops, organic farming, various disposal methods for invasive plants)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 describe linkages between local communities and economies and the green industries *(e.g., consumer needs and green industry goods and services, green industries as sources of jobs and tax revenues, communities as providers of services to green industries and as regulators of green industry activities)*;

C2.2 analyse societal issues relating to the green industries, and identify ways of resolving them, taking a variety of perspectives into account *(e.g., effects on Aboriginal hunting and harvesting territories, land use conflicts such as parkland versus commercial development, property rights and municipal landscape management, animal welfare, rights of migrant workers, fair trade concerns relating to imported agricultural or floral products, fuel ethanol versus food production)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and apply safe working practices as they relate to the green industries;

D2. demonstrate an understanding of the business and regulatory environment of the green industries;

D3. identify careers in the green industries, and describe the skills, education, and training required for entry into these occupations.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify the personal protective clothing and equipment needed to perform various green industry tasks safely, and use as required to ensure their own and others' safety in the work environment (*e.g., eye and ear protection; hand, head, and foot protection; sun protection; equipment guards*);

D1.2 demonstrate an understanding of environmental and site-related hazards (*e.g., land conditions; weather conditions; crew competence and organization; presence of utility lines, glass structures, hanging limbs, chicots*) and apply appropriate safety measures for avoiding them (*e.g., roping off an area, setting up caution signs, removing hazards, implementing traffic control measures*);

D1.3 demonstrate an understanding of and apply safe procedures for using and maintaining materials, tools, and equipment (*e.g., avoid moving parts and pinch points; perform a circle check of vehicles and equipment; check condition of materials, hydraulic systems, and protective equipment; check oil and fuel levels*);

D1.4 demonstrate an understanding of and apply safe procedures for handling plants and/or animals (*e.g., dethorning plants, using ergonomic lifting techniques or devices, using hand protection, securing loads correctly for transport, understanding animal perception, avoiding actions that startle animals, using chutes and restraining devices*);

D1.5 identify potentially hazardous situations in the workplace by conducting and documenting personal and workplace safety audits;

D1.6 identify sources of information about workplace hazards and how to avoid them (*e.g., Workplace Hazardous Materials Information System [WHMIS], Passport to Safety*);

D1.7 outline and comply with legislation for protecting the health and safety of workers in the green industries (*e.g., Occupational Health and Safety Act, local by-laws, fire prevention regulations*).

D2. Business and Regulatory Environment

By the end of this course, students will:

D2.1 identify a variety of industry-related organizations (*e.g., local growers' associations; government departments; non-governmental organizations*), and demonstrate an understanding of their role with respect to the green industries;

D2.2 explain principles, concepts, and practices related to the marketing and distribution of commodity products and/or services (*e.g., product branding; advertising approaches such as health- and lifestyle-related campaigns; market opportunities and challenges such as exports and international/ interprovincial competition; distribution considerations such as shipping of live plants and animals, warehouse requirements, and product life*);

D2.3 outline and comply with legislation and guidelines governing the quality and safety of green industry products and services (*e.g., product quality regulations, grading standards, inspection requirements, voluntary guidelines such as the Landscape Ontario guidelines for the landscaping industry*).

D3. Career Opportunities

By the end of this course, students will:

D3.1 describe careers in the green industries *(e.g., landscape architect, forest manager, horticulturalist, farm manager, turf manager, botanist, veterinarian)* and the education, training, and certification required for entry into these occupations;

D3.2 identify ways of acquiring knowledge and experience in green industry occupations *(e.g., through part-time work experience, cooperative education, guest speakers, field trips, job shadowing)*;

D3.3 identify the size and composition of the labour force and the career opportunities available in the green industries in their local and regional communities;

D3.4 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the green industries *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D3.5 demonstrate an understanding of and apply the Essential Skills that are important for success in the green industries, as identified in the Ontario Skills Passport *(e.g., reading text, writing, document use, computer use, oral communication, numeracy, thinking skills)*;

D3.6 demonstrate an understanding of and apply the work habits that are important for success in the green industries *(e.g., working safely, teamwork, reliability, initiative, customer service)*;

D3.7 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in areas related to the green industries *(e.g., Passport to Safety certificate, technical reports, competency checklists, Ontario Skills Passport Work Plan)*, and explain why having a current portfolio is important for career development and advancement.

Green Industries, Grade 11

Workplace Preparation   THJ3E

This course enables students to develop knowledge and skills related to agriculture, floristry, forestry, horticulture, and landscaping. Students will learn to identify a broad range of plant and animal species; examine factors that affect the growth of plants and animals and the quality of products derived from them; and develop process, design, and maintenance skills required in the green industries. Students will also learn about safe and healthy working practices, develop an awareness of environmental and societal issues related to green industry activities, and learn about apprenticeships and other postsecondary education and training opportunities, as well as employment opportunities that may be pursued directly after graduation.

Prerequisite: None

A. GREEN INDUSTRY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of species classification and identification and of relationships between species and geographical regions;

A2. demonstrate an understanding of the effects of biotic and abiotic factors on growth and product quality;

A3. demonstrate an understanding of design and planning processes and their application to a variety of requirements in the green industries;

A4. use mathematical, documentation, research, and communication skills as they apply to the green industries.

SPECIFIC EXPECTATIONS

A1. Species Classification and Geographical Regions

By the end of this course, students will:

A1.1 distinguish between different plant and/or animal groups and identify them by key characteristics and desirable features *(e.g., annuals and perennials; native and non-native plants; major types, species, and varieties of trees, shrubs, flowering plants, and crops; animal breeds)*;

A1.2 identify geographical regions on the basis of classification criteria relevant to the green industries *(e.g., forest type, hardiness, soil type)*;

A1.3 explain the relationships between geographical regions and the key characteristics and desirable features of plant and/or animal groups within them *(e.g., relationship of plant and animal characteristics to available heat, moisture, light, shelter, and food)*.

A2. Factors Affecting Growth and Product Quality

By the end of this course, students will:

A2.1 identify the main abiotic factors that affect growth and post-harvest quality *(e.g., temperature, sunlight, soil composition, rainfall and soil moisture)*;

A2.2 describe biological processes that are essential to the propagation, development, and health of plants and/or animals and the quality of products derived from them *(e.g., photosynthesis,* respiration, reproduction, transpiration, post-harvest physiology, digestion)*;

A2.3 identify a variety of pests and diseases *(e.g., bacteria, viruses, moulds, fungi, insects, animals)* that may affect the health of plants and/or animals and the quality of products derived from them.

A3. Designs and Processes

By the end of this course, students will:

A3.1 describe the steps in a design or planning process (see pp. 22–23) and demonstrate an understanding of their application to a variety of requirements in the green industries *(e.g., preparing environmental farm plans, urban forestry management plans, landscape designs; designing water gardens, mass arrangements)*;

A3.2 describe common operational processes that are used in the green industries *(e.g., single animal management, crop location and rotation, crop scheduling, event planning, waste management, composting, select cutting)*;

A3.3 identify a variety of structures used in the green industries *(e.g., cold frames, greenhouses, toolsheds, animal pens, storage facilities)*, and describe how their structural features relate to their functions;

A3.4 demonstrate an understanding of correct procedures for the care and handling of plants and/or animals *(e.g., propagating, pruning, transporting, watering, feeding, fertilizing)*.

A4. Technological and Mathematical Literacy and Communication Skills

By the end of this course, students will:

A4.1 demonstrate an understanding of terminology used in the green industries and use it correctly in oral and written communication *(e.g., pulp, deciduous, form flower, scale, loam)*;

A4.2 use effective documentation practices to record and track important information related to green industry operations *(e.g., preparing estimates, inventories, and invoices; maintaining cleaning and maintenance records, food source records, pesticide field logs, crop management records)*;

A4.3 identify technical issues of current significance in the green industries, using information from general media sources *(e.g., newspapers, magazines, the Internet)*;

A4.4 use appropriate calculations and units of measurement when completing a variety of green industry tasks *(e.g., calculating fertilizer and preservative applications, yields, basal areas; surveying; calibrating sprayers; converting between metric and imperial units)*.

B. GREEN INDUSTRY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. demonstrate an understanding of and apply design and production practices that are commonly used in the green industries;

B2. apply management strategies for assessing and controlling biotic and abiotic factors that affect plant and/or animal quality;

B3. demonstrate competence in technical skills relating to specific applications and tasks in the green industries.

SPECIFIC EXPECTATIONS

B1. Design and Production

By the end of this course, students will:

B1.1 implement a production process or procedures according to a design or plan *(e.g., harvest a crop, construct a landscape, grow and cultivate plants, make floral arrangements)*;

B1.2 demonstrate an understanding of and apply techniques for the propagation and care of plants and animals and for ensuring the quality of products derived from them *(e.g., plant/tree regeneration, animal reproduction, cut flower processing, crop production, tree planting)*;

B1.3 demonstrate an understanding of and apply techniques and processes that promote biodiversity, increase ecosystem function, and reduce maintenance requirements *(e.g., planting of native species, mulching, naturalizing gardens, using local cut flowers)*;

B1.4 demonstrate an understanding of and apply marketing techniques that are commonly used in the green industries *(e.g., creation of product displays, posters, and pamphlets)*.

B2. Plant and Animal Management Strategies

By the end of this course, students will:

B2.1 apply a variety of methods to monitor biotic factors that affect plant and/or animal quality *(e.g., pest scouting, regular health inspections of animals, weed identification, post-harvest tracking of product freshness and quality)*;

B2.2 apply a variety of methods to monitor abiotic factors that affect plant and/or animal quality *(e.g., nutrient balancing, soil testing, monitoring indoor and outdoor environmental conditions)*;

B2.3 apply a variety of pest and disease control techniques *(e.g., crop rotation, greenhouse sanitation, enhancement of natural barriers, disinfection of equipment)*.

B3. Technical Skills

By the end of this course, students will:

B3.1 demonstrate competence in the basic technical skills required to complete a variety of tasks in the green industries *(e.g., rigging loads, operating power tools, wiring and taping flowers, using a guillotine cutter to cut natural and manufactured products, applying pesticide)*;

B3.2 construct a variety of structures or products that are used or produced in the green industries *(e.g., planter boxes, scaffolding, seasonal crafts, pavers, fences, skid trails)*;

B3.3 demonstrate competence in related technical skills *(e.g., welding, small-engine maintenance, use of computer applications, use of GPS equipment)* that are required to complete a variety of green industry projects.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. identify the impact of the green industries on the environment and describe ways of minimizing harmful effects;

C2. describe social and economic relationships and issues involving the green industries.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 describe the effects of green industry activities on the environment in the past and in the present *(e.g., destruction of habitat, increased energy use for long-distance shipping of floral products, pesticide and fertilizer contamination, greenhouse gas emissions from tillage and sheep and cattle, noise and air pollution from gasoline- and diesel-powered machinery)*;

C1.2 describe the advantages and disadvantages of using natural rather than manufactured materials or products in the green industries *(e.g., natural fertilizers and pest control methods rather than chemical fertilizers and pesticides, real flowers rather than artificial flowers, real grass rather than artificial turf, untreated rather than pressure-treated lumber)*;

C1.3 identify sustainable practices and guidelines that are currently applied within the green industries or may be applied in the future *(e.g., environmental farm planning, sustainable forest management, integrated pest management, sustainable golf course maintenance, select spraying, energy-efficient greenhouse production)*;

C1.4 describe the environmental implications *(e.g., effects on landfill lifespan and water and air quality)* of using particular materials, products, processes, and disposal methods *(e.g., chemically treated wood products; recycling, reusing, composting; using correct disposal methods for invasive plants)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 identify linkages between local communities and economies and the green industries *(e.g., consumer needs and green industry goods and services, green industries as sources of jobs and tax revenues, communities as providers of services to green industries and as regulators of green industry activities)*;

C2.2 describe societal issues relating to the green industries and identify ways of resolving them *(e.g., effects on Aboriginal hunting and harvesting territories, land use conflicts such as parkland versus commercial development, property rights and municipal landscape management, animal welfare, rights of migrant workers, fair trade concerns relating to imported agricultural or floral products)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and apply safe working practices as they relate to the green industries;

D2. identify careers in the green industries, and describe the skills, education, and training required for entry into these occupations.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify the personal protective clothing and equipment needed to perform various green industry tasks safely, and use as required to ensure their own and others' safety in the work environment *(e.g., eye and ear protection, hand and foot protection, head protection, sun protection, equipment guards)*;

D1.2 demonstrate an understanding of environmental and site-related hazards *(e.g., land conditions, weather conditions, dangerous plants and animals, utility lines, glass structures, hanging limbs, chicots)* and apply appropriate safety measures for avoiding them *(e.g., roping off danger areas, removing hazards, setting up traffic controls)*;

D1.3 demonstrate an understanding of and apply safe procedures for using and maintaining materials, tools, and equipment *(e.g., avoid moving parts and pinch points; perform a circle check of vehicles and equipment; check condition of materials, hydraulic systems, and protective equipment; check oil and fuel levels)*;

D1.4 demonstrate an understanding of and apply safe procedures for handling plants and/or animals *(e.g., dethorning plants, using ergonomic lifting techniques or devices, using hand protection, securing loads correctly for transport, understanding animal perception, avoiding actions that startle animals, using chutes and restraining devices)*;

D1.5 identify potentially hazardous situations in the workplace by conducting and documenting personal and workplace safety audits;

D1.6 identify sources of information about workplace hazards and how to avoid them *(e.g., Workplace Hazardous Materials Information System [WHMIS], Passport to Safety)*;

D1.7 outline and comply with legislation for protecting the health and safety of workers in the green industries *(e.g., Occupational Health and Safety Act, local by-laws, fire prevention regulations)*.

D2. Career Opportunities

By the end of this course, students will:

D2.1 describe careers *(e.g., arborist, florist, herder, greenhouse worker, forester)* in the sectors of the green industries and the education, training, and certification required for entry into these occupations;

D2.2 identify ways of acquiring knowledge and experience in green industry occupations *(e.g., through part-time work experience, cooperative education, guest speakers, field trips, job shadowing)*;

D2.3 identify the size of the labour force and the employment opportunities available in the green industries in their local community;

D2.4 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the green industries *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.5 demonstrate an understanding of and apply the Essential Skills that are important for success in the green industries, as identified in the Ontario Skills Passport *(e.g., reading text, writing, document use, computer use, oral communication, numeracy, thinking skills)*;

D2.6 demonstrate an understanding of and apply the work habits that are important for success in the green industries *(e.g., working safely, teamwork, reliability, initiative, customer service, and entrepreneurship)*;

D2.7 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in areas related to the green industries *(e.g., Passport to Safety certificate, reports, assignments, Ontario Skills Passport Work Plan, industry certifications)*, and explain why having a current portfolio is important for career development and advancement.

Green Industries,
Grade 12

University/College Preparation

THJ4M

This course focuses on more complex concepts and skills related to the green industries. Students will focus on developing process skills, design and management techniques, and ways of enhancing environmental sustainability. They will also examine social and economic issues related to the green industries, learn about safe and healthy working practices, study industry standards and codes, and explore career opportunities. The knowledge and skills acquired in this course will prepare students for more specialized studies at the college and university level.

Prerequisite: Green Industries, Grade 11, University/College Preparation

A. GREEN INDUSTRY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of species classification and identification and explain relationships between species and geographical regions;

A2. analyse the effects of biotic and abiotic factors on growth and post-harvest quality;

A3. develop and evaluate designs or processes for a variety of applications in the green industries;

A4. use mathematical, documentation, research, and communication skills as they apply to the green industries.

SPECIFIC EXPECTATIONS

A1. Species Classification and Geographical Regions

By the end of this course, students will:

A1.1 distinguish between different plant and/or animal groups on the basis of key identification characteristics *(e.g., native and non-native species, dairy and beef cattle, deciduous and coniferous shrubs, monocotyledonous and dicotyledonous plants)*, and identify species using both common and scientific names *(e.g., white birch [also known as paper birch or canoe birch] [Betula papyrifera] and Mountain paper birch [Betula cordifolia], euonymus [gen. Euonymus] and Emerald Gaiety [Euonymus fortunei 'Emerald Gaiety'])*;

A1.2 identify geographical regions in Canada on the basis of classification criteria relevant to the green industries *(e.g., plant hardiness, growing degree days, elevation, soil type, soil moisture)*, and explain how geographical factors determine the distribution of species in these regions;

A1.3 compare different kinds of ecosystems in terms of their biodiversity *(e.g., a climax forest versus a rejuvenated forest, natural versus managed land, a cultivated field versus a greenhouse)*, and explain how biodiversity affects the stability of ecosystems *(e.g., monocultures versus diversified ecosystems)*.

A2. Factors Affecting Growth and Product Quality

By the end of this course, students will:

A2.1 analyse the effects of abiotic factors on growth and post-harvest quality *(e.g., effects of differences in soil composition, climate, water quality and quantity, topography)*;

A2.2 analyse the effects of biotic factors on growth and post-harvest quality *(e.g., physiological effects of pests and diseases, invasive species, genetic variations)*;

A2.3 assess the effects of interactions between abiotic, biotic, and cultural factors on a variety of ecosystems *(e.g., forests in various stages of natural succession, golf courses, fish farms, organic farms, riparian zones)*;

A2.4 compare the effectiveness of different integrated pest management techniques for a variety of applications *(e.g., cultural [tilling and mulching], physical [crop rotation], environmental [introduction of beneficial insects], biological [fungi, nutrients], chemical [pheromones, chemical pesticides])*.

A3. Designs and Processes

By the end of this course, students will:

A3.1 explain the steps required to create designs or plans for a variety of applications in the green industries *(e.g., timber cruising, surveying, perennial gardens, farms, environmental assessments)*;

A3.2 explain advanced systems, processes, and techniques relating to the propagation, maintenance, and care of plants or animals *(e.g., irrigation systems, tree support and protection systems, plantation tending, prescribed burning, regeneration)*;

A3.3 evaluate the appropriateness and effectiveness of a management process *(e.g., environmental impact assessment, tree or crop loss assessment, herd health evaluation, growth and yield monitoring)*;

A3.4 describe how advanced technologies and scientific knowledge are being applied to processes in the green industries *(e.g., geographical information systems, global positioning devices, three-dimensional CAD applications, aerial and satellite images, computerized feeding systems, computerized inventory systems, genetic modification)*, and assess their impacts.

A4. Technological and Mathematical Literacy and Communication Skills

By the end of this course, students will:

A4.1 demonstrate an understanding of terminology used in the green industries and use it correctly in oral and written communication *(e.g., biodiversity, tendril, balance, pergola, tilth)*;

A4.2 apply effective documentation practices to a variety of procedures related to green industry operations *(e.g., record data from timber cruises; maintain production and maintenance records; document Hazard Analysis and Critical Control Point [HACCP] activities; prepare inventories, estimates, and invoices)*;

A4.3 interpret charts, graphs, aerial photographs, maps, and other visual presentations of information used in the green industries;

A4.4 analyse commercial or technical issues of current significance in the green industries, using information from media and industry sources *(e.g., marketing boards, industry organizations, commodity websites, trade publications, news reports)*;

A4.5 accurately perform complex measurements and calculations required for advanced applications in the green industries *(e.g., basal area prism sweeps, pricing, surveys, economic forecasts, grade and slope measurements)*.

B. GREEN INDUSTRY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. demonstrate an understanding of and apply design and production practices that are commonly used in the green industries;

B2. develop and apply management strategies for assessing and controlling biotic, abiotic, and cultural factors that affect plant and/or animal quality;

B3. demonstrate competence in technical skills relating to specific applications and tasks within the green industries.

SPECIFIC EXPECTATIONS

B1. Design and Production

By the end of this course, students will:

B1.1 develop a design and/or process that fulfills a specific functional or aesthetic requirement *(e.g., a graphic design, a barn design, a specialty garden design, an urban forest regeneration schedule, an advertising brochure; specialty pruning techniques)*;

B1.2 design and implement a management plan or site layout for a specific application *(e.g., a natural disturbance response and restoration plan, a site survey and construction implementation plan for a landscape design, a growing system for plant production and distribution, plant selection and schedule for crop rotation, animal housing, an urban forest development plan)*;

B1.3 demonstrate competence in the use of biological techniques for propagating and maintaining a variety of species *(e.g., cone selection, transplanting large trees, reforestation, insect control, hybridization, grafting, artificial insemination)*;

B1.4 create plans or designs for green industry projects that enhance biodiversity *(e.g., moisture conservation, xeriscaping, integrating diverse native plants, sustainable water gardening)*.

B2. Plant and Animal Management Strategies

By the end of this course, students will:

B2.1 analyse biotic conditions affecting the health of plants and/or animals and the quality of products derived from them, using a variety of diagnostic procedures *(e.g., pest counts, pest determination, microscopic investigation, visual inspection, blood testing, cavity assessment)*;

B2.2 analyse abiotic conditions affecting the health of plants and/or animals and the quality of products derived from them, using a variety of diagnostic procedures *(e.g., nutrient balance testing, soil and water testing, form defect analysis, air quality assessment)*;

B2.3 apply a variety of pest and disease control techniques *(e.g., integrated pest management, crop rotation, animal inoculation, instituting invasive species controls)*, and assess their effects on plant and/or animal stock and the environment;

B2.4 develop and apply best management practices for enhancing environmental sustainability within the green industries *(e.g., herd management, native species selection and placement, forest certification, cut selection, local purchasing, composting, integrated pest management, water management, biogas production from wastes)*.

B3. Technical Skills

By the end of this course, students will:

B3.1 demonstrate competence in the technical skills required to complete a variety of projects or processes in the green industries *(e.g., using or programming a computerized climate control system, measuring trees, grading land, formulating feed)*;

B3.2 build a variety of structures that are commonly used in the green industries *(e.g., roads, skid trails, pens, pergolas, retaining walls, brick pavements)*;

B3.3 demonstrate competence in related technical skills required to complete projects within the green industries *(e.g., welding, wiring, making electrical repairs, plumbing, small-engine operation and maintenance, graphic communication, veterinary procedures such as administering medications)*;

B3.4 demonstrate competence in specialized technical skills required for unique applications *(e.g., installing low-voltage lighting, working at heights, xeriscaping, topiary shaping, using specialized software applications)*.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. assess options for achieving environmental sustainability in green industry operations;

C2. analyse social, economic, and cultural relationships involving the green industries.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 evaluate green industry operations and processes in terms of their impacts on environmental sustainability *(e.g., global floral sourcing and greenhouse gas emissions, by-product management and water quality, monocultures and biodiversity, genetically modified products and effects on pesticide use and biodiversity)*;

C1.2 analyse ways of reducing negative or enhancing positive environmental consequences through the use of particular materials, products, processes, and disposal methods *(e.g., nutrient recycling, spot spraying for insects and fungus, using organic fertilizer, composting, xeriscaping)*;

C1.3 describe methods used in the green industries to balance economic sustainability with environmental responsibilities *(e.g., selective breeding, selective cutting, organic production methods, restricted cattle crossings and buffer zones to prevent water contamination, environmental best management practices)*;

C1.4 describe the benefits of alternative practices that reduce the environmental impact of green industry operations *(e.g., living walls, natural-scaping, xeriscaping, forest certification, tree marking guidelines, fibre crops, armatures and grid work, alternative animal housing systems)*;

C1.5 describe legislation, regulations, standards, and guidelines relating to environmental protection that affect operations in the green industries. *(e.g. Greenbelt Act, Fisheries Act, Crown Forest Sustainability Act, Nutrient Management Act, Forest Fires Prevention Act, pest control regulations)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 analyse ways in which the green industries are affected by the social, economic, and cultural characteristics of the communities in which they operate *(e.g., relations with Aboriginal communities, ethnic preferences and demands for specialized food products, income distribution and demand for landscaping services and horticultural products, age profile of community and requirements for different types of outdoor recreation facilities)*;

C2.2 assess the economic importance of linkages between the green industries and related industries and technologies *(e.g., **agriculture:** food processing industry, farm implement industry; **horticulture:** shipping industry, event-related businesses [funeral homes, wedding planners]; **landscaping:** recreational industries, small-engine industry; **forestry:** heavy equipment industry, paper-consuming industries such as newspapers)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and apply safe working practices as they relate to the green industries;

D2. demonstrate an understanding of the business and regulatory environment of the green industries;

D3. identify careers in the green industries that require postsecondary education, and describe the qualifications required for entry into these occupations.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 describe common industry hazards (*e.g., ergonomic hazards, mechanical hazards, chemical hazards*) and sources of information about accident prevention (*e.g., Workplace Hazardous Materials Information System [WHMIS], Passport to Safety*);

D1.2 identify the personal protective clothing and equipment needed to perform various green industry tasks safely, and use as required to ensure their own and others' safety in the work environment (*e.g., safety glasses, hard hats, safety boots, fall protection gear, equipment guards*);

D1.3 demonstrate the ability to make appropriate safety decisions for personnel on the basis of environmental and site conditions (*e.g., weather conditions, presence of poisonous plants or dangerous gases, hazardous trees, reliability of communications in remote areas, access to emergency services*) and level of crew training and experience;

D1.4 demonstrate an understanding of and apply safe procedures for using and maintaining materials, tools, and equipment (*e.g., avoid moving parts and pinch points; perform a circle check of vehicles and equipment; check condition of materials, hydraulic systems, and protective equipment; check oil and fuel levels*);

D1.5 demonstrate an understanding of and apply safe procedures for handling plants and/or animals (*e.g., dethorning plants, using ergonomic lifting techniques or devices, using hand protection, securing loads correctly for transport, understanding animal perception, avoiding actions that startle animals, using chutes and restraining devices*);

D1.6 demonstrate an understanding of specific components of the Occupational Health and Safety Act (*e.g., use of hazardous materials in the workplace, duties of employers, rights and responsibilities of workers*).

D2. Business and Regulatory Environment

By the end of this course, students will:

D2.1 identify industry associations, government departments, and non-governmental organizations that are involved with matters that affect the green industries (*e.g., local growers' associations; provincial and federal agriculture, health, environment, and resource departments; environmental NGOs*);

D2.2 explain economic principles, concepts, and arrangements that affect operations in the green industries (*e.g., transportation routes, bonuses, quota system, free trade, treaties, supply and demand*);

D2.3 outline and comply with legislation and guidelines governing the quality and safety of green industry products and services (*e.g., product quality regulations, grading standards, inspection requirements, voluntary guidelines such as the Landscape Ontario guidelines for the landscaping industry*).

D3. Career Opportunities

By the end of this course, students will:

D3.1 identify careers in the green industries that require postsecondary education, and describe the nature of the work in these occupations;

D3.2 describe the educational programs, training, and certification needed for entry into a variety of green industry occupations requiring post-secondary education;

D3.3 investigate areas of specialization within the green industries *(e.g., lighting systems, water features, irrigation systems, GIS analysis, robotics, automation, entomology, pathology, tissue culture, agronomy, marketing, environmental management, farm management)*;

D3.4 identify the scope and strength of the labour force within the green industries regionally, nationally, and internationally;

D3.5 demonstrate an understanding of and apply the Essential Skills that are important for success in the green industries, as identified in the Ontario Skills Passport *(e.g., reading text, writing, document use, computer use, oral communication, numeracy, thinking skills)*;

D3.6 demonstrate an understanding of and apply the work habits that are important for success in the green industries, as identified in the Ontario Skills Passport *(e.g., initiative, organization, accountability, ethical conduct)*;

D3.7 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in areas related to the green industries *(e.g., Passport to Safety certificate, technical reports, competency checklists, Ontario Skills Passport Work Plan)*, and explain why having a current portfolio is important for career development and advancement.

Green Industries, Grade 12

Workplace Preparation   THJ4E

This course enables students to gain further experience with a variety of industry procedures and operations and to acquire additional industry-specific skills. Students will study more complex processes, develop more advanced design and maintenance skills, and explore ways of enhancing environmental sustainability. They will also examine social and economic issues related to the green industries, learn about safe and healthy working practices, study industry standards and codes, and explore career opportunities in the various industries. The knowledge and skills acquired in this course will prepare students for the workplace and apprenticeship training.

Prerequisite: Green Industries, Grade 11, Workplace Preparation

A. GREEN INDUSTRY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of species classification and identification and of relationships between species and geographical regions;

A2. demonstrate an understanding of the effects of biotic and abiotic factors on growth and product quality;

A3. demonstrate an understanding of designs and processes related to a variety of green industry applications;

A4. use mathematical, documentation, research, and communication skills as they apply to the green industries.

SPECIFIC EXPECTATIONS

A1. Species Classification and Geographical Regions

By the end of this course, students will:

A1.1 use common classification schemes and key identification characteristics to distinguish between different plant and/or animal groups *(e.g., annuals versus perennials, deciduous versus coniferous trees and shrubs, oaks versus birches, Holsteins versus Ayrshires)*;

A1.2 identify geographical regions on the basis of classification criteria relevant to the green industries *(e.g., plant hardiness, growing degree days, elevation, soil type, soil moisture),* and describe how geographical factors determine the distribution of species in these regions;

A1.3 compare different kinds of ecosystems in terms of their biodiversity *(e.g., a climax forest versus a rejuvenated forest, natural versus managed land, a cultivated field versus a greenhouse).*

A2. Factors Affecting Growth and Product Quality

By the end of this course, students will:

A2.1 describe the effects of abiotic factors *(e.g., light, temperature, soils, nutrients, topography, moisture, climate change, ethylene gas)* on plant and/or animal growth and post-harvest quality *(e.g., a southern exposure may increase yields by increasing available light; too little moisture may stunt growth* and reduce yields; too much moisture may encourage growth of mould and mildew; ethylene gas acts as a ripening agent for picked fruits);*

A2.2 describe the effects of biotic factors *(e.g., pests, diseases, weeds)* on plant and/or animal growth and post-harvest quality *(e.g., form defects, stunted growth, reduced yields, damaged fruit);*

A2.3 describe the effects of interactions between abiotic, biotic, and cultural factors in a variety of environments *(e.g., gardens, greenhouses, barns, florists' coolers, fields, forest stands);*

A2.4 describe a variety of integrated pest management techniques *(e.g., cultural [tilling and mulching], physical [crop rotation], environmental [introduction of beneficial insects], biological [fungi, nutrients], chemical [pheromones, chemical pesticides]),* and identify situations in which they can be applied effectively.

A3. Designs and Processes

By the end of this course, students will:

A3.1 describe how design or planning processes are used in a variety of green industry applications *(e.g., preparation of species prescriptions, crop rotation plans, environmental assessments, site layouts, event plans);*

A3.2 explain processes and techniques relating to the propagation, maintenance, and care of plants and/or animals *(e.g., animal breeding, taking cuttings, seeding, irrigation, pruning, clipping, feeding, clearing)*;

A3.3 describe new technologies that are being applied to the green industries *(e.g., computerized inventory systems, automated watering systems, aerial and satellite imaging)*.

A4. Technological and Mathematical Literacy and Communication Skills

By the end of this course, students will:

A4.1 demonstrate an understanding of terminology used in the green industries and use it correctly in oral and written communication *(e.g., board feet, petiole, focalization, terrace, humus)*;

A4.2 use effective documentation practices to record and track important information *(e.g., preparing estimates, recording costs, recording crop yields, preparing inventories, completing equipment maintenance records)*;

A4.3 identify technical issues of current significance in the green industries, using information from general media sources *(e.g., newspapers, magazines, the Internet)*;

A4.4 perform measurements and calculations accurately for a variety of green industry applications *(e.g., determining basal area, animal weight, crown size, slope; invoicing; surveying)*.

B. GREEN INDUSTRY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. demonstrate an understanding of and apply design and production practices that are commonly used in the green industries;

B2. apply management strategies for assessing and controlling biotic and abiotic factors that affect plant and/or animal quality;

B3. demonstrate competence in technical skills relating to specific applications and tasks in the green industries.

SPECIFIC EXPECTATIONS

B1. Design and Production

By the end of this course, students will:

B1.1 develop a design or process for a green industry application (*e.g., a landscape design, a crop production plan, a herd management procedure, a plant propagation schedule*);

B1.2 devise an effective management plan or site layout for a specific application (*e.g., a forest prescription, a herd management plan, an event plan, a landscape construction plan, a block layout and harvesting plan, animal housing*);

B1.3 demonstrate an understanding of and apply techniques related to the propagation, maintenance, and post-harvest handling of a variety of species (*e.g., pruning, scarification of forest floor, artificial insemination, transplanting large trees, cut flower conditioning*);

B1.4 demonstrate an understanding of and apply designs and production processes that promote biodiversity, increase ecosystem function, and reduce maintenance requirements (*e.g., mulching, sustainable water gardening, rooftop gardening, naturalizing landscapes*);

B1.5 demonstrate an understanding of and apply marketing techniques that are commonly used in the green industries (*e.g., product displays, flyer advertising, promotional websites*).

B2. Plant and Animal Management Strategies

By the end of this course, students will:

B2.1 perform a variety of procedures (*e.g., pest counts, microscopic investigations, visual inspections, estrous cycle monitoring*) to assess biotic conditions that affect plant and/or animal quality;

B2.2 perform a variety of procedures (*e.g., soil and air temperature measurement, water analysis, form defects analysis, air quality assessment, nutritional assessment, monitoring ethylene gas concentrations*) to assess or measure abiotic conditions that affect plant and/or animal quality;

B2.3 apply techniques for controlling pests and disorders of plants and/or animals (*e.g., fogging, density planting, encouraging beneficial insects, constructing barriers, setting live traps, inoculations, animal tagging*);

B2.4 demonstrate an understanding of and apply management techniques that enhance environmental sustainability within the green industries (*e.g., sustainable herd management practices, measures that enhance forest succession, preferential use of native species*).

B3. Technical Skills

By the end of this course, students will:

B3.1 demonstrate competence in the technical skills required to complete a variety of tasks or

processes in the green industries *(e.g., tractor operation, use of hydraulics, mason saw operation, tree removal, pruning, floral mechanics, operation of computerized feeding equipment)*;

B3.2 construct a variety of structures or products that are used in the green industries *(e.g., arbours, boardwalks, retaining walls, raised beds, skid trails, biogas generator)*;

B3.3 demonstrate competence in related technical skills required for success within a variety of green industries *(e.g., construction, manufacturing, plumbing, wiring and electrical repair, diesel engine operation, graphic communication, artistic design)*;

B3.4 demonstrate competence in specialized technical skills required for unique applications *(e.g., working at heights, water gardening, breeding animals, grafting, creating new convention designs, using specialized software applications)*.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. assess the impact of the green industries on the environment and describe ways of enhancing environmental sustainability;

C2. describe social, economic, and cultural relationships involving the green industries.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 assess the environmental sustainability of various practices and procedures used in the green industries (*e.g., harvesting methods, wood product manufacturing methods, naturalized land-scaping, global floral sourcing, environmental farm plans, crop rotation, large-scale farming*);

C1.2 describe ways of reducing negative or enhancing positive environmental consequences through the use of particular materials, products, processes, and disposal methods (*e.g., nutrient recycling, spot spraying for insects and fungus, using organic fertilizer, composting, xeriscaping*);

C1.3 describe methods used in the green industries to balance economic sustainability with environmental responsibilities (*e.g., selective breeding, selective cutting, organic production methods, environmental best management practices*);

C1.4 describe the benefits of alternative practices that reduce the environmental impact of green industry operations (*e.g., living walls, naturalscaping, forest certification, tree marking guidelines, fibre crops, armatures and grid work, alternative animal housing systems*);

C1.5 identify legislation, regulations, standards, and guidelines relating to environmental protection that affect operations in the green industries (*e.g. Clean Water Act, Nutrient Management Act, species importation regulations, tree-cutting by-laws, pest control regulations*).

C2. Technology and Society

By the end of this course, students will:

C2.1 describe ways in which the green industries are affected by the social, economic, and cultural characteristics of the communities in which they operate (*e.g., relations with Aboriginal communities, ethnic preferences and demands for specialized food products, income distribution and demand for landscaping services and horticultural products, age profile of community and requirements for different types of outdoor recreation facilities*);

C2.2 identify related industries and describe how they and the green industries are interdependent (*e.g., small-engine manufacturing and lawn care, nutrient research and animal/crop production, equipment manufacturing and farming*).

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and apply safe working practices as they relate to the green industries;

D2. demonstrate an understanding of the business and regulatory environment of the green industries;

D3. identify careers in the green industries, and describe the skills, education, and training required for entry into these occupations.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify common industry hazards (*e.g., ergonomic hazards, mechanical hazards, chemical hazards*) and sources of information about accident prevention (*e.g., Workplace Hazardous Materials Information System [WHMIS], Passport to Safety*);

D1.2 identify the personal protective clothing and equipment needed to perform various green industry tasks safely, and use as required to ensure their own and others' safety in the work environment (*e.g., safety glasses, hard hats, safety boots, fall protection gear*);

D1.3 demonstrate the ability to make appropriate safety decisions that take account of environmental conditions and worker preparedness (*e.g., level of training or experience, access to seasonal work wear, comfort level around large animals, fire response capabilities, weather and site hazards*);

D1.4 demonstrate an understanding of and apply safe procedures for using and maintaining materials, tools, and equipment (*e.g., avoid moving parts and pinch points; perform a circle check of vehicles and equipment; check condition of materials, hydraulic systems, and protective equipment; check oil and fuel levels*);

D1.5 demonstrate an understanding of and apply safe procedures for handling plants and/or animals (*e.g., dethorning plants, using ergonomic lifting techniques or devices, using hand protection, securing loads correctly for transport, understanding animal perception, avoiding actions that startle animals, using chutes and restraining devices*);

D1.6 demonstrate an understanding of specific components of the Occupational Health and Safety Act and other safety-related requirements that relate to the green industries (*e.g., Ontario Forestry Safe Workplace Association guidelines, Grower Pesticide Safety Course certificate, Forest Fires Prevention Act*).

D2. Business and Regulatory Environment

By the end of this course, students will:

D2.1 identify a variety of industry-related organizations (*e.g., local growers' associations, government departments, non-governmental organizations*), and demonstrate an understanding of their role with respect to the green industries;

D2.2 identify basic economic concepts and principles that affect operations in the green industries (*e.g., cost of production and transportation, supply and demand*);

D2.3 outline and comply with legislation and guidelines governing the quality and safety of green industry products and services (*e.g., product quality regulations, grading standards, inspection requirements, voluntary guidelines such as the Landscape Ontario guidelines for the landscaping industry*).

D3. Career Opportunities

By the end of this course, students will:

D3.1 identify careers in the green industries (*e.g., arborist, florist, herder, greenhouse worker, forester*), and describe the nature and scope of the work involved;

D3.2 describe the education, training, and certification required for employment in various occupations in the green industries;

D3.3 describe areas of specialization within the green industries *(e.g., lighting systems, water features, irrigation systems, sawmill operation, sod farming, nursery production, dairy herd inspection)* and the qualifications required to work in these areas;

D3.4 identify ways of acquiring knowledge and experience in green industry occupations *(e.g., through part-time work experience, cooperative education, guest speakers, field trips, job shadowing)*;

D3.5 identify the scope and strength of the labour force within the green industries regionally, nationally, and internationally;

D3.6 demonstrate an understanding of and apply the Essential Skills that are important for success in the green industries, as identified in the Ontario Skills Passport *(e.g., reading text, writing, document use, computer use, oral communication, numeracy, thinking skills)*;

D3.7 demonstrate an understanding of and apply the work habits that are important for success in the green industries, as identified in the Ontario Skills Passport *(e.g., initiative, ethical conduct, accountability, entrepreneurship, customer service)*;

D3.8 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in areas related to the green industries *(e.g., Passport to Safety certificate, reports, assignments, Ontario Skills Passport Work Plan)*, and explain why having a current portfolio is important for career development and advancement.

HAIRSTYLING AND AESTHETICS

Hairstyling and aesthetics courses offer students an opportunity to work in a salon/spa environment and provide services for a diverse clientele. Students may focus on careers such as hairstylist, aesthetician, nail technician, or make-up artist. In a growing service economy, courses in hairstyling and aesthetics help prepare students for rewarding careers.

Students will gain hands-on experience using professional materials and equipment and practising current techniques. They will use professional terminology related to hairstyling and aesthetics, acquire transferable problem-solving skills, and learn about the Essential Skills and work habits that are important for success in these fields. At the same time, they will expand their communication and interpersonal skills as they interact with their peers and clients.

The list of approved emphasis areas for hairstyling and aesthetics can be found at www.edu.gov.on.ca/eng/curriculum/secondary/teched.html.

- Courses in technological education are suitable for use in cooperative education programs and in connection with other forms of experiential learning as well as in programs such as the Specialist High Skills Major (SHSM). For more information, see pages 43–44 of this document.
- For policy guidelines pertaining to multiple-credit courses and emphasis courses, see pages 17–18 of this document.

Hairstyling and Aesthetics, Grade 11

Workplace Preparation   TXJ3E

This course enables students to develop knowledge and skills in cosmetology and offers a variety of applications that will equip students to provide services for a diverse clientele. Students will identify trends in the hairstyling and aesthetics industry, learn about related health and safety laws, and expand their communication and interpersonal skills through interactions with peers and clients. Students will also consider environmental and societal issues related to the industry, and will acquire a more detailed knowledge of apprenticeships and direct-entry work positions.

Prerequisite: None

A. HAIRSTYLING AND AESTHETICS FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of the physiology of hair, skin, and nails;

A2. demonstrate an understanding of issues related to chemical components found in hairstyling and aesthetics products;

A3. demonstrate an understanding of business practices and strategies used in the hairstyling and aesthetics industry.

SPECIFIC EXPECTATIONS

A1. The Physiology of Hair, Skin, and Nails

By the end of this course, students will:

A1.1 describe the physiological properties of hair, skin, and nails (*e.g., density, elasticity, porosity, texture, cycles of growth*);

A1.2 use correct terminology to discuss the properties of hair, skin, and nails (*e.g., **hair:** anagen, telogen, catagen; **skin:** sebum, melanin, dermatology, epidermis; **nails:** onyx, keratin*).

A2. Chemical Components and Related Issues

By the end of this course, students will:

A2.1 explain the role of pH values in hair care, skin care, and nail care products (*e.g., **hair products:** shampoo, conditioners, chemical relaxers, permanent wave solutions, peroxide, neutralizers; **skin products:** moisturizers, cleansing creams, toners; **nail products:** acrylic overlays, UV gels, liquid nail wraps, primers*);

A2.2 identify common chemical ingredients that may trigger allergic reactions and list products that do and do not contain the ingredients (*e.g., organic/natural products, synthetic compounds, hypoallergenic cosmetics*).

A3. Business Practices and Strategies

By the end of this course, students will:

A3.1 identify and describe behaviours, attitudes, and skills that are important for successful employment in the hairstyling and aesthetics

industry (*e.g., commitment to the job and to a high standard of performance, professional appearance and dress, task management skills, interpersonal skills, respect for confidentiality, commitment to antidiscriminatory practices, conflict-resolution skills*);

A3.2 use a variety of teamwork and interpersonal skills to communicate and interact successfully with clients and co-workers (*e.g., understand and accommodate cultural differences in body language and communication style – for instance, many First Nations people show respect by not looking into the eyes of the person they are speaking to*);

A3.3 identify effective advertising and management strategies (*e.g., appeal to new client groups, including diverse populations*) and new products, tools, and equipment that can be used to support and enhance salon/spa operations;

A3.4 identify a range of visual display techniques that are used in the hairstyling and aesthetics industry to attract clients (*e.g., window/display showcases, holiday themes and promotions*) and compare their effectiveness in different retail and service contexts;

A3.5 apply literacy skills (*e.g., to read manufacturers' instructions, product ingredients and directions*) and mathematical skills (*e.g., to measure volume and/or proportions*) to ensure the safe and appropriate use of hairstyling and aesthetics techniques, tools, and products;

A3.6 explain the purpose and importance of a client consultation form and waiver (*e.g., name, address, allergies, current products, client wishes, client history*).

B. HAIRSTYLING AND AESTHETICS SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. perform a variety of salon/spa services that meet industry standards, using appropriate materials, techniques, and equipment safely and correctly;

B2. create designs for a variety of hairstyling and aesthetics purposes and contexts;

B3. apply methods for identifying, analysing, and meeting the needs of a diverse clientele.

SPECIFIC EXPECTATIONS

B1. Performing Salon/Spa Services

By the end of this course, students will:

B1.1 select and use appropriate materials, tools, and products to perform professional salon/spa services (*e.g., hair colouring, hair cutting, hairstyling, chemical texturizing, make-up applications, nail care and skin care treatments*);

B1.2 demonstrate a working knowledge of products, techniques, and tools used to perform hairstyling and aesthetics services (*e.g., **products:** gel, pomade, mousse, wax, hairspray, lightener, neutralizer, milk cleanser, toner, peel, serum, creams, oils; **techniques:** for cutting, colouring, and styling hair; **tools:** thermal irons, hair brushes/combs, scissors, texture shears, razors, clippers, high-frequency machines, nail files, cuticle pushers, nail buffers, comedone extractors*);

B1.3 perform an in-depth hair, scalp, and product analysis to predict the results that can be expected from chemical services (*e.g., consult with client; perform strand test and patch test; study product information and application instructions to assess product appropriateness and effects*);

B1.4 perform hairstyling and aesthetics services (*e.g., hair cutting, hairstyling, make-up, nail care, skin care*) to meet the needs of individuals and groups in school and community contexts (*e.g., special event occasions, musicals, plays, productions, fashion shows, nursing homes, hospitals*).

B2. Creating Designs

By the end of this course, students will:

B2.1 use knowledge of elements of design (*e.g., space, line, texture*) and design principles (*e.g., scale, rhythm, contrast*) to plan hairstyling and aesthetics strategies;

B2.2 use colour theory principles and tools (*e.g., "warm" and "cool" shades, complementary colours, colour wheel*) to customize hairstyling and aesthetics services to meet individual clients' needs (*e.g., to develop appropriate colour formulations and/or make-up selections*);

B2.3 incorporate hairstyling and aesthetics fashion trends (*e.g., cutting, styling, and colouring patterns; make-up styles; nail art*) and culturally based styles/products (*e.g., ethnic styles, henna*) into their designs;

B2.4 produce creative designs for a variety of salon/spa purposes and contexts (*e.g., styles for competitions and fashion shows; seasonal, fantasy, bridal/prom, and men's styles*);

B2.5 demonstrate an understanding of make-up design and application approaches and techniques appropriate to a variety of purposes and/or contexts (*e.g., special occasion, glamour, workplace-appropriate, culturally specific, fantasy, camouflage, classic make-up; make-up to simulate the "look" of various historical periods*).

B3. Meeting the Needs of Clients

By the end of this course, students will:

B3.1 demonstrate the ability to communicate effectively with the client, using active listening techniques *(e.g., asking questions to clarify client's expressed wishes; not interrupting while client is speaking; being attuned to culturally distinct communication styles)*;

B3.2 develop and analyse a profile of a client *(e.g., condition of scalp, hair, skin, and nails; skin type; facial shape; body type)* in order to recommend appropriate hairstyling and aesthetics services;

B3.3 use organizational record-keeping skills to keep track of information about clients and business operations *(e.g., release statements, client record cards, appointments, employee work schedules)*.

C. INDUSTRY PRACTICES, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. describe the environmental impact of practices and products in the hairstyling and aesthetics industry, and identify safe practices and environmentally friendly solutions to problems;

C2. explain why hairstyling and aesthetics services are important to society, and identify ways in which social and cultural factors affect the industry.

SPECIFIC EXPECTATIONS

C1. Industry Practices and the Environment

By the end of this course, students will:

C1.1 identify and explain environmental and health issues related to various products used in the hairstyling and aesthetics industry *(e.g., the need for biodegradable products and refillable containers; the need for warnings/controls for carcinogenic/toxic ingredients; the need for proper ventilation in salons/spas);*

C1.2 describe and apply practices for the recycling and responsible disposal of waste from salon/spa operations *(e.g., routines to reduce, reuse, and recycle; techniques for safe handling)*, and identify some sustainable purchasing practices for the hairstyling and aesthetics industry *(e.g., purchasing products available in refillable containers, products with natural ingredients, non-toxic cleaning products, energy-saving products).*

C2. Industry Practices and Society

By the end of this course, students will:

C2.1 describe the role that the hairstyling and aesthetics industry plays in increasing people's self-esteem and well-being *(e.g., fostering a positive body image, good personal grooming and hygiene, and self-confidence; reducing stress; identifying health issues)* at the various life stages *(e.g., child, preteen, teenager, young/middle-aged adult, senior);*

C2.2 describe how the hairstyling and aesthetics industry responds to various social issues and concerns *(e.g., the use of animal testing in product development; the use of natural versus synthetic ingredients in product development; demand for scent-free and hypoallergenic products; cultural protocols, such as the Anishinaabe practice of collecting cut hair to dispose of in a culturally acceptable way);*

C2.3 identify culturally linked fashion preferences or restrictions in hairstyling and aesthetics *(e.g., related to hair length and/or visibility, eyebrow styles, make-up styles, hair colour, hair removal, henna, hair extensions).*

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. apply health and safety standards related to the use of hairstyling and aesthetics equipment, materials, and techniques and the maintenance of a safe work environment;

D2. identify and describe a variety of career opportunities and related training and education requirements in the hairstyling and aesthetics industry.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify and describe key aspects of the laws, regulations, and regulatory/oversight bodies that govern the hairstyling and aesthetics industry *(e.g., the Occupational Health and Safety Act, the Workplace Hazardous Materials Information System [WHMIS], the Apprenticeship and Certification Act [Restricted Skill Sets], the Food and Drugs Act – Cosmetic Regulations; the Canadian Centre for Occupational Health and Safety)*;

D1.2 use safe and sanitary work practices to prevent the spread of pathogens and protect their own and others' health *(e.g., sanitize, disinfect, and/or sterilize implements and equipment; work in a well-ventilated space; wear safety glasses and appropriate clothing; handle products correctly; practise good posture and apply ergonomic principles; wash hands frequently; use deodorant regularly)*;

D1.3 demonstrate an understanding of procedures to ensure safe and productive work practices in the hairstyling and aesthetics workplace *(e.g., using a checklist to keep track of tools and equipment; developing and following routines/protocols for the correct use of scissors, curling irons, electric cords, waxing heaters, autoclave, glass bead sterilizer, steamer, chemicals)*;

D1.4 identify emergency situations that might occur in salon/spa settings *(e.g., cuts, burns, electrocution, allergic reactions, epileptic seizures, diabetic shock)* and describe appropriate responses and/or first-aid treatments.

D2. Career Opportunities

By the end of this course, students will:

D2.1 identify apprenticeship, certification, and postsecondary entry requirements related to careers in the hairstyling and aesthetics industry *(e.g., apprenticeship training and red seal certification, college programs, private career college programs)*;

D2.2 use a career-planning process to research, identify, and describe secondary and postsecondary goals, plans, and pathways related to the hairstyling and aesthetics industry *(e.g., identify personal interests and attributes; investigate education and career opportunities in the school, community, and workplace; decide which opportunities to select and plan the transitions between stages)*;

D2.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the hairstyling and aesthetics industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the hairstyling and aesthetics industry, as identified in the Ontario Skills Passport *(e.g., oral communication, measurement and calculation, job task planning and organizing)*;

D2.5 demonstrate an understanding of and apply the work habits that are important for success in the hairstyling and aesthetics industry, as identified in the Ontario Skills Passport *(e.g., working safely, reliability, customer service)*;

D2.6 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in hairstyling and aesthetics *(e.g., work logs, skills checklist, Passport to Safety certificate, Ontario Skills Passport Work Plan, before-and-after photographs of mannequins and live models)*, and explain why having a current portfolio is important for career development and advancement.

Hairstyling and Aesthetics, Grade 12

Workplace Preparation

TXJ4E

This course enables students to develop increased proficiency in a wide range of hairstyling and aesthetics services. Working in a salon/spa team environment, students will strengthen their fundamental cosmetology skills and develop an understanding of common business practices and strategies in the salon/spa industry. Students will also expand their understanding of environmental and societal issues and their knowledge of postsecondary destinations in the hairstyling and aesthetics industry.

Prerequisite: Hairstyling and Aesthetics, Grade 11, Workplace Preparation

A. HAIRSTYLING AND AESTHETICS FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of aspects of human physiology that are relevant to hairstyling and aesthetics;

A2. demonstrate knowledge of the chemical properties of hairstyling and aesthetics products and their physical effects on hair, skin, and nails;

A3. demonstrate an understanding of effective business practices and strategies for salon/spa operators, managers, and owners.

SPECIFIC EXPECTATIONS

A1. The Physiology of Hair, Skin, and Nails

By the end of this course, students will:

A1.1 describe the physiological properties of hair, skin, and nails, as identified through research *(e.g., hydrogen and sulfur bonds; end bonds; capacity for absorption, sensation, and excretion; function within the circulatory system; growth patterns)*;

A1.2 use correct terminology to discuss the properties of hair, skin, and nails *(e.g., **hair:** trichology, hypertrichosis; **skin:** sudoriferous glands, sebum; **nails:** onyx, onychosis)*;

A1.3 describe symptoms of and treatments for diseases and disorders of the hair, skin, and nails *(e.g., **hair:** lice, dandruff [Pityriasis capitis], alopecia, canities; **skin:** boils, acne, tinea, scabies; **nails:** hangnail [agnail], wavy ridges, fungus, ingrown nail [onychocryptosis])*.

A2. Chemical Components and Related Issues

By the end of this course, students will:

A2.1 identify and describe potential negative effects *(e.g., hair breakage, skin irritation, allergic reaction)* of chemical applications to the hair, skin, and nails *(e.g., **hair:** colouring, lighteners, soft curl texturizers; **skin:** alphahydroxy acids [AHA], topical solutions; **nails:** artificial nails, nail polish removers)*;

A2.2 use a pH chart to summarize the differences between the acid and alkaline levels of a variety of hair and skin products *(e.g., permanent wave solutions, shampoos, peroxides, skin care products)* and explain how these products affect the hair, skin, and nails;

A2.3 describe chemical changes that take place during hairstyling procedures *(e.g., oxidation-reduction reactions, breakdown of sulfur bonds, action of sodium hydroxide, action of lighteners/hair colours and neutralizers)*.

A3. Business Practices and Strategies

By the end of this course, students will:

A3.1 identify the business and entrepreneurial procedures involved in operating and/or opening a business in the hairstyling and aesthetics industry *(e.g., developing a business plan, arranging a lease and contracts, registering the business, managing commissions, controlling inventory, arranging insurance coverage)*;

A3.2 describe marketing techniques and strategies used in the hairstyling and aesthetics industry and evaluate their effectiveness;

A3.3 identify and describe a variety of uses of computer software in the hairstyling and aesthetics industry *(e.g., for design/image makeover, scheduling, billing, marketing)*;

A3.4 identify important requirements of professional ethics and customer relations in the hairstyling and aesthetics industry *(e.g., client confidentiality, use of approved products and equipment, use of accredited employees, complaint/conflict-resolution strategies, up-selling strategies, professional etiquette)* and explain the legal and business implications of non-compliance with these requirements *(e.g., loss of business, loss of reputation, potential lawsuits for violating privacy laws)*;

A3.5 explain the importance of literacy skills *(e.g., for understanding manufacturers' directions, WHMIS labels, and information sheets)* and mathematical skills *(e.g., for measuring application amounts, calculating cash transactions and commissions, budgeting, accounting)* in the hairstyling and aesthetics industry.

B. HAIRSTYLING AND AESTHETICS SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. use professional techniques to perform salon/spa services that meet industry standards;

B2. demonstrate complex and innovative hairstyling and aesthetics design techniques;

B3. use a variety of approaches to meet the hairstyling and aesthetics needs of a diverse clientele professionally and effectively;

B4. demonstrate exemplary practices for maintaining a safe and healthy work environment for students and clients.

SPECIFIC EXPECTATIONS

B1. Performing Salon/Spa Services

By the end of this course, students will:

B1.1 perform effectively a variety of fashion cuts that accentuate clients' best features, using techniques that meet industry standards (*e.g., texturizing, point cutting, blending, razor cutting, tapered cutting, blunt cutting, layer cutting, clipper cutting*);

B1.2 perform services that chemically alter the structure of hair (*e.g., hair colouring/highlighting, chemical texturizing*) using a variety of techniques;

B1.3 use skin and hair analysis procedures to identify and provide the most suitable service for the client, using the most appropriate products, equipment, and techniques (*e.g., manicures, pedicures, skin treatments, eyebrow shaping, make-up application, hair removal, thermal styling, wet styling, wig and hair enhancement, chemical treatments, hair cutting, corrective treatments, creative competition styles, fantasy designs*).

B2. Creating Designs

By the end of this course, students will:

B2.1 propose and plan hairstyling and aesthetics styles and procedures for clients (*e.g., develop appropriate style designs; sketch styling and cutting patterns*);

B2.2 apply colour theory concepts (*e.g., colour wheel, "warm" and "cool" shades, complementary colours*) in planning and performing hairstyling and aesthetics services (*e.g., hair colour formulations, make-up selections*);

B2.3 create hairstyling and aesthetics designs that demonstrate an understanding of fashion and cultural trends and preferences;

B2.4 use a design process to create increasingly complex or challenging hairstyling and aesthetics proposals for various situations (*e.g., competitions, seasonal occasions, special events, requests for custom nail designs*);

B2.5 use a design process to create increasingly complex or challenging make-up application approaches and techniques appropriate to various purposes and/or contexts (*e.g., special occasion, glamour, fantasy, camouflage, classic or culturally specific make-up; make-up to simulate the "look" of various historical periods*).

B3. Meeting the Needs of Clients

By the end of this course, students will:

B3.1 identify the hair and skin characteristics (*e.g., texture, porosity, elasticity, density*) of individual clients and the most appropriate products and services to meet each client's needs;

B3.2 use a consultation process that draws on a variety of sources of information (*e.g., client record, product information, colour chart, fashion magazines*) to identify appropriate services for different types of clients (*e.g., within the school or community*);

B3.3 advise clients on home care and preventive measures for the treatment of hair, skin, and nail abnormalities;

B3.4 use constructive conflict-management strategies and problem-solving skills when interacting with difficult clients or co-workers in problematic situations;

B3.5 use money-management and record-keeping skills *(e.g., for tracking commissions, tips, taxes, retail transactions, appointments, inventory)* to ensure that hairstyling and aesthetics services are provided in a businesslike manner.

B4. Maintaining a Safe and Healthy Work Environment

By the end of this course, students will:

B4.1 use safe and healthy work practices in performing hairstyling and aesthetics services *(e.g., proper handling of equipment, monitoring of contra-indications and benefits for all treatments and products)*;

B4.2 identify and report potential problems that might lead to an unsanitary, unsafe, or unhealthy work environment *(e.g., problems related to electrical cords, spillage, chemical products, contaminated tools, inadequate ventilation, contact with blood or body fluids, disposal of syringes)*;

B4.3 use ergonomic work practices to reduce health risks for self and clients *(e.g., adjust stools, tables, chairs, aesthetic beds, and/or trolleys to the optimum height)*;

B4.4 demonstrate an understanding of procedures for maintaining a safe and productive work environment *(e.g., develop an inspection routine and a safety checklist for tools and operations)* and engage in professional activities that will keep them informed about the most current health and safety practices and issues in the industry *(e.g., read current professional literature, join professional associations)*;

B4.5 explain why regular exercise and good nutrition *(e.g., as outlined in* Eating Well with Canada's Food Guide *[2007], as well as* Eating Well with Canada's Food Guide: First Nations, Inuit and Métis, *and the various cultural adaptations of Canada's Food Guide available from the Ontario Public Health Association)* are important for maintaining healthy hair, skin, and nails and personal wellness.

C. INDUSTRY PRACTICES, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. evaluate practices and products in the hairstyling and aesthetics industry in terms of their impact on the environment;

C2. evaluate the hairstyling and aesthetics industry in terms of its impact on society.

SPECIFIC EXPECTATIONS

C1. Industry Practices and the Environment

By the end of this course, students will:

C1.1 summarize best practices for the safe handling, recycling, and disposal of waste *(e.g., use of biodegradable products and refillable containers, proper methods for storing and disposing of products and chemicals)* and develop a method *(e.g., a checklist)* for evaluating/monitoring the practices of individual salons/spas;

C1.2 evaluate the hairstyling and aesthetics industry in terms of its use/non-use of environmentally friendly practices and products *(e.g., use of recycling programs for mannequins; use of non-toxic versus carcinogenic/toxic ingredients; use of energy-saving products)*.

C2. Industry Practices and Society

By the end of this course, students will:

C2.1 assess the beneficial and harmful impacts on society of the hairstyling and aesthetics industry *(e.g., **beneficial:** enhances people's self-esteem and self-confidence through improvements in appearance; promotes awareness and acceptance of culturally diverse types of beauty; **harmful:** fosters unrealistic expectations through media and advertising images; encourages over-emphasis on the importance of appearance for social success)*;

C2.2 identify sources of work-related stress in the hairstyling and aesthetics industry *(e.g., **physical stresses:** exposure to chemicals, standing for long hours; **social/psychological stresses:** irregular hours, working evenings and weekends)* and describe ways of dealing with them.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. explain the purpose of legislation related to health and safety in the hairstyling and aesthetics industry;

D2. identify and describe career opportunities and related training and education requirements in the hairstyling and aesthetics industry.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 demonstrate knowledge of health and safety legislation and regulatory/oversight bodies that govern the hairstyling and aesthetics industry, explain their purpose, and describe how they affect the industry (*e.g., the Food and Drugs Act – Cosmetic Regulations, the Occupational Health and Safety Act, the Workplace Hazardous Materials Information System [WHMIS], the Apprenticeship and Certifications Act [Restricted Skill Sets], the Smoke-Free Ontario Act; the Canadian Centre for Occupational Health and Safety*);

D1.2 use safe and sanitary work practices to prevent the spread of pathogens and protect their own and others' health (*e.g., sanitize, disinfect, and/or sterilize implements and equipment; work in a well-ventilated space; wear safety glasses and appropriate clothing; handle products correctly; wash hands frequently; use deodorant regularly*);

D1.3 identify health and safety certification and training that are appropriate for the hairstyling and aesthetics industry (*e.g., first aid, cardiopulmonary resuscitation [CPR], Passport to Safety certificate, automated external defibrillation [AED]*) and organizations that offer health and safety information, training, and certification (*e.g., the Workplace Hazardous Materials Information System [WHMIS], the Red Cross, St. John Ambulance*).

D2. Career Opportunities

By the end of this course, students will:

D2.1 compare and evaluate a wide variety of careers in the hairstyling and aesthetics industry (*e.g., hairstylist, barber, hair colour specialist, chemical technician, nail technician, retail specialist, wig or extensions specialist, aesthetician, salon manager, salon owner, product educator, make-up artist, massage therapist, cosmetic chemist, medi-spa technician, teacher*);

D2.2 list a variety of methods of identifying employment opportunities in the hairstyling and aesthetics industry (*e.g., searching electronic job banks, reading classified ads, networking, delivering résumés to local businesses, using student services*);

D2.3 demonstrate an understanding of and apply the Essential Skills that are important for success in the hairstyling and aesthetics industry, as identified in the Ontario Skills Passport (*e.g., problem solving, finding information, computer skills*);

D2.4 demonstrate an understanding of and apply the work habits that are important for success in the hairstyling and aesthetics industry, as identified in the Ontario Skills Passport (*e.g., teamwork, initiative, customer service*);

D2.5 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in hairstyling and aesthetics (*e.g., Passport to Safety certificate, before-and-after photographs of mannequins and live models, Ontario Skills Passport Work Plan and Transition Plan*), and explain why having a current portfolio is important for career development and advancement.

HEALTH CARE

Health care courses offer students an opportunity to investigate factors contributing to personal health and, at the same time, gain an introduction to a range of careers in the health care industry. These careers include, but are not limited to, child care worker, dental assistant/dentist, gerontologist, laboratory technician/technologist, doctor, nursing assistant/nurse, pharmacy assistant/pharmacist, and personal support worker. Courses in health care help prepare students for rewarding careers in a sector that is set to expand rapidly as our population ages.

Students will gain hands-on experience using industry-standard instruments, equipment, and materials and practising current techniques. They will learn the professional terminology of the field, acquire transferable problem-solving skills, and expand their communication and interpersonal skills as they interact with their peers and clients in a variety of simulated care scenarios. As they acquire theoretical understanding and practical skills in their areas of interest, students will become better prepared to make informed career choices.

The list of approved emphasis areas for health care can be found at www.edu.gov.on.ca/eng/curriculum/secondary/teched.html.

- Courses in technological education are suitable for use in cooperative education programs and in connection with other forms of experiential learning as well as in programs such as the Specialist High Skills Major (SHSM). For more information, see pages 43–44 of this document.
- For policy guidelines pertaining to multiple-credit courses and emphasis courses, see pages 17–18 of this document.

Health Care, Grade 11

University/College Preparation   TPJ3M

This course enables students to develop their understanding of basic health care procedures, including the safe use of appropriate instruments, equipment, and materials. Students will focus on health care fundamentals, including the anatomical features and physiology of the major body systems and the factors that affect homeostasis in the human body. Students will develop an awareness of health and safety issues in the health care field, analyse environmental and societal issues related to health care, and learn about professional practice standards and career opportunities in the field.

Prerequisite: None

A. HEALTH CARE FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of health care terminology and its correct usage;

A2. demonstrate a basic understanding of human anatomy and physiology;

A3. demonstrate an understanding of homeostasis and its relationship to personal health;

A4. describe the relationship between lifestyle choices and personal health and well-being;

A5. compare conventional and complementary methods of disease prevention and treatment.

SPECIFIC EXPECTATIONS

A1. Health Care Terminology

By the end of this course, students will:

A1.1 demonstrate an understanding of health care terminology (*e.g., manifestation, obstruction*), and use it correctly in oral and written communication;

A1.2 demonstrate an understanding of terminology related to human physiology (*e.g., hormone, cerebral vascular accident [stroke]*), and use it correctly in oral and written communication;

A1.3 demonstrate an understanding of anatomical terminology (*e.g., proximal, hypochondrium*), and use it correctly in oral and written communication;

A1.4 identify and use medical abbreviations correctly (*e.g., pt [patient], ECG [electrocardiogram]*);

A1.5 name and identify the purpose of commonly used health care equipment (*e.g., X-ray machine, phlebotomy equipment, refraction equipment, walker frames, autoclave*);

A1.6 pronounce and spell key health care terms correctly (*e.g., febrile = feb-ril; distal = dis-təl*).

A2. Anatomy and Physiology

By the end of this course, students will:

A2.1 demonstrate an understanding of the basic structure of the human body (*e.g., cells, tissues, organs, systems*);

A2.2 identify the four main types of tissue (*i.e., muscle tissue, nervous tissue, epithelial tissue, connective tissue*) and describe their basic functions;

A2.3 demonstrate a basic understanding of the integumentary system (*e.g., skin layers and their components, sensory perception*);

A2.4 demonstrate a basic understanding of the musculoskeletal system (*e.g., types of movement such as flexion, extension, rotation, abduction*);

A2.5 demonstrate a basic understanding of the cardiovascular system (*e.g., by building a model of the heart to show major anatomical features and blood flow*);

A2.6 identify the major structures of the lymphatic system and explain how it is related to the cardiovascular and immune systems (*e.g., lymphatic vessels and lymph nodes remove bacteria to protect the body*);

A2.7 demonstrate a basic understanding of the respiratory system (*e.g., by building a functional respiratory model to illustrate the mechanism of breathing*);

A2.8 demonstrate a basic understanding of the digestive system (*e.g., by building a model to illustrate the digestive pathway*);

A2.9 identify the three main areas of the neurological system (*i.e., cerebrum, cerebellum, brain stem*) and describe their function;

A2.10 demonstrate an understanding of visual indicators of health status that should be noted when carrying out a health assessment of an individual (*e.g., skin appearance [normal, bruised, jaundiced], breathing, posture, height, weight, alertness, balance, gait, signs of malnourishment*).

A3. Homeostasis

By the end of this course, students will:

A3.1 describe the various balances that the body regulates in order to maintain a stable internal environment *(e.g., temperature, blood glucose, acid/base, blood pressure, fluid balance)*;

A3.2 identify factors that can create a homeostatic imbalance *(e.g., vomiting/diarrhea can lead to dehydration and electrolyte imbalance)*;

A3.3 explain how imbalances in body systems affect personal health *(e.g., an imbalance in blood glucose can lead to hypoglycemia/hyperglycemia)*.

A4. Lifestyle Choices

By the end of this course, students will:

A4.1 identify and describe lifestyle choices that can improve a person's health and well-being *(e.g., avoidance of substance use/abuse, stress management, regular exercise, prevention of dental cavities, safe use of MP3 players and cell phones, using an Aboriginal medicine wheel as a health framework)*;

A4.2 assess a simulated client's dietary strengths and weaknesses and make appropriate food and nutrition suggestions, using appropriate resources *(e.g.,* Eating Well with Canada's Food Guide *[2007];* Eating Well with Canada's Food Guide: First Nations, Inuit and Métis; *cultural adaptations of Canada's Food Guide available from the Ontario Public Health Association)*;

A4.3 identify and describe different types of community health and social services that help people maintain active and healthy lives *(e.g., community care access centres, nursing, mental health services, physiotherapy, lab services, Meals on Wheels, vision services, dental services, pharmacy services)*.

A5. Disease Prevention and Treatment

By the end of this course, students will:

A5.1 research and describe conventional medical treatments for disease, disability, or injury *(e.g., cancer – radiation treatment, chemotherapy, surgery; cholelithiasis – diet, lithotripsy, microscopic surgery, pain control)*;

A5.2 research and describe complementary medical treatments for disease, disability, or injury *(e.g., acupuncture for pain management, First Nations ritual of smudging to purify and cleanse the body, therapeutic touch)*;

A5.3 describe a variety of conventional and complementary methods of preventing and treating disease that can be combined to provide a holistic approach *(e.g., prescribed and over-the-counter medication, meditation, herbal remedies, chiropractic treatment, naturopathy, massage therapy, surgery)*;

A5.4 demonstrate an understanding of the chain of infection and the principles of infection control.

B. HEALTH CARE SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. use health care instruments, equipment, and materials safely and correctly;

B2. demonstrate the ability to use vital signs to determine a client's health status;

B3. demonstrate the ability to apply health care skills and techniques safely and to industry standards;

B4. demonstrate the ability to apply a variety of techniques for communicating with clients and collecting client information.

SPECIFIC EXPECTATIONS

B1. Instruments, Equipment, and Materials

By the end of this course, students will:

B1.1 identify common medical instruments (*e.g., sphygmomanometer, forceps, double-ended explorer*), equipment (*e.g., Hoyer lift, intravenous [IV] pole, weigh scales, microscope, mouth mirror*), and materials (*e.g., wound dressings, bed linens and lift sheets, gloves, protective gowns, eye shields*), and use them safely and correctly;

B1.2 disinfect instruments and equipment, using accepted medical aseptic procedures, to prevent the spread of infection (*e.g., nosocomial infection secondary to contaminated medical equipment/devices*);

B1.3 prepare, clean, and store instruments and equipment correctly, following standard industry procedures (*e.g., calibrate sphygmomanometer correctly prior to use, prepare instruments for autoclaving, clean pill cutter before and after use*).

B2. Vital Signs

By the end of this course, students will:

B2.1 demonstrate the ability to measure the four primary vital signs (temperature, pulse, respiration, blood pressure) and to assess degree of pain (often considered an additional vital sign);

B2.2 assess and document a client's vital signs: temperature (by oral, axillary, and tympanic routes); pulse rate (rhythm and volume by apical and radial sites); respiration rate (rhythm and character); blood pressure; and pain intensity (*e.g., using a pain scale*);

B2.3 identify normal values for temperature, pulse, respiration, and blood pressure across the life-span, and assess possible health implications of abnormal values (*e.g., elevated temperature suggests a possible infection; an elevated blood pressure reading may be an early indication of hypertension*).

B3. Skills and Techniques

By the end of this course, students will:

B3.1 demonstrate an understanding of correct hand hygiene procedures (*e.g., knowing when they are required, knowing when to use hand washing rather than antibacterial sanitizers*), and apply as required;

B3.2 perform common caregiving skills and techniques (*e.g., bed making, bed bathing, feeding, toileting, oral care, weighing*) safely and correctly, using baby and/or adult mannequins;

B3.3 perform mobility techniques (*e.g., turning, lifting, and transferring clients; using crutches or walkers and instructing clients in their use*) safely and correctly;

B3.4 perform a range of motion and positioning techniques safely and correctly to prevent the development of decubitus ulcers and contractures in clients;

B3.5 demonstrate an understanding of (*e.g., through role play*) and apply health and safety procedures relating to proper body mechanics and ergonomics (*e.g., base of support, good body posture*);

B3.6 perform basic physical assessment skills *(e.g., assessment of visual acuity using a Snellen Chart; assessment of hearing, breath sounds, bowel sounds, gait and balance; neurological assessment).*

B4. Communication and Documentation

By the end of this course, students will:

B4.1 demonstrate the ability to use therapeutic communication techniques *(e.g., active listening and paraphrasing)* in a variety of client situations *(e.g., clients recovering from a stroke, clients with dementia, clients dealing with pain and stressful situations);*

B4.2 identify various communication barriers *(e.g., barriers relating to health conditions, age, stage of development, and differing cultural communication styles)* and apply strategies for overcoming them;

B4.3 demonstrate competence in the use of methods for collecting client data and documenting client information *(e.g., role play how to interview a client to obtain a client history).*

C. HEALTH CARE, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. describe the impact of health care industry activities on the environment and identify ways of minimizing their harmful consequences;

C2. describe the impact of current social patterns and trends on personal health and the delivery of health care.

SPECIFIC EXPECTATIONS

C1. Health Care and the Environment

By the end of this course, students will:

C1.1 describe the potential impact on the environment of biohazardous waste from health care facilities *(e.g., body fluid and human tissue, sharps containing bacteria or viruses);*

C1.2 identify safe methods for the handling, storage, and disposal of waste and biohazardous materials *(e.g., use of checklists, sharps containers, double wrapping, proper labelling);*

C1.3 describe good environmental practices that can be applied in the health care industry *(e.g., using energy-efficient lighting; reducing, reusing, or recycling packaging material; storing information electronically instead of on paper).*

C2. Health Care and Society

By the end of this course, students will:

C2.1 identify demographic and lifestyle patterns and trends *(e.g., an aging population, lack of exercise)* and describe their implications for the health care industry *(e.g., increased obesity and susceptibility to diabetes and cardiovascular disease, changes in care needs, changes in treatments and interventions, trends in mental illness and public attitudes towards it);*

C2.2 research and analyse the relationship between socio-economic status and health *(e.g., differences in various health parameters among children aged 4 to 6 from different socio-economic backgrounds).*

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and comply with safe working practices and the laws and regulations governing the health and safety of workers in the health care industry;

D2. demonstrate an understanding of legal and ethical standards governing the practice of health care;

D3. describe career opportunities in the health care field and related educational requirements.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify and comply with legislation, regulations, standards, and requirements pertaining to worker safety in the health care workplace *(e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS])*;

D1.2 demonstrate an understanding of and apply procedures to ensure safe and productive work practices in the health care workplace *(e.g., use tools and equipment safely as outlined in safety manuals, operating instructions, and institutional requirements; conduct a safety inspection or audit of a facility; use a checklist to keep track of tools and equipment)*;

D1.3 use protective clothing and equipment as required to keep themselves and others safe and free from harm.

D2. Professional Standards

By the end of this course, students will:

D2.1 identify and explain the principal components of legislation pertaining to health care in Ontario *(e.g., Regulated Health Professions Act [RHPA] sets the framework for regulating the scope of practice of health professions)*;

D2.2 explain the need for the professional and ethical standards that health care workers are expected to adhere to *(e.g., accountability, knowledge, competence, respect for patients' rights and privacy, respect for cultural and religious diversity, respect for the sanctity of life)*.

D3. Career Opportunities

By the end of this course, students will:

D3.1 identify various career opportunities in health care and describe the education and/or training required for entry into these occupations;

D3.2 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the health care industry *(e.g., mentoring programs, virtual networking/support groups, specialized post-secondary programs, relevant industry associations)*;

D3.3 demonstrate an understanding of and apply the Essential Skills that are important for success in the health care industry, as identified in the Ontario Skills Passport *(e.g., document use, decision making, finding information)*;

D3.4 demonstrate an understanding of and apply the work habits that are important for success in the health care industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability)*;

D3.5 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in health care *(e.g., Passport to Safety certificate, reports, assignments, Ontario Skills Passport Work Plan)*, and explain why having a current portfolio is important for career development and advancement.

Health Care,
Grade 11

College Preparation   TPJ3C

This course enables students to develop their understanding of basic health care proce-
dures, including the safe use of appropriate instruments, equipment, and materials.
Students will focus on health care fundamentals, including health care terminology and
the anatomical features and physiology of some major body systems. Students will devel-
op an awareness of health and safety issues in the health care field, environmental and
societal issues related to health care, professional practice standards, and career opportuni-
ties in the field.

Prerequisite: None

A. HEALTH CARE FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of health care terminology and its correct usage;

A2. demonstrate a basic understanding of human anatomy and physiology;

A3. demonstrate a basic understanding of homeostasis and its relationship to personal health;

A4. describe the relationship between lifestyle choices and personal health and well-being;

A5. compare conventional and complementary methods of disease prevention and treatment.

SPECIFIC EXPECTATIONS

A1. Health Care Terminology

By the end of this course, students will:

A1.1 demonstrate an understanding of fundamental health care terminology *(e.g., hypertension, jaundice, diabetes, obstruction, acute, chronic)*, and use it correctly in oral and written communication;

A1.2 demonstrate an understanding of anatomical terminology *(e.g., positional [mandibular], directional [anterior/posterior], motion [abduction])*, and use it correctly in oral and written communication;

A1.3 name and identify the purpose of commonly used health care equipment *(e.g., X-ray machine, phlebotomy equipment, refraction equipment, walker frames, autoclave)*;

A1.4 pronounce and spell key health care terms correctly *(e.g., proximal = **prox-ih-mahl**)*.

A2. Anatomy and Physiology

By the end of this course, students will:

A2.1 describe the different types of tissue and the different types of cells and cell arrangements that characterize them *(e.g., epithelial tissues make up the skin and inner body surfaces and are composed of tightly packed cells)*;

A2.2 identify the components of the musculoskeletal system *(e.g., major bones and muscles)* and describe how they function *(e.g., describe how different kinds of joints move)*;

A2.3 identify the components of the cardiovascular system *(e.g., heart and heart components, veins, arteries)*, and demonstrate an understanding of how they function *(e.g., by building a model of the heart to show major anatomical features and blood flow)*;

A2.4 identify the components of the respiratory system *(e.g., larynx, epiglottis, trachea, lungs, and lung components)*, and demonstrate an understanding of how they function *(e.g., by building a functional model to illustrate the mechanism of breathing)*;

A2.5 identify the three main areas of the neurological system *(i.e., cerebrum, cerebellum, brain stem)* and describe their function;

A2.6 identify the basic components of the digestive system *(e.g., mouth, pharynx, esophagus, stomach, small and large intestines, gall bladder, liver)*, and demonstrate an understanding of how they function *(e.g., by building a model to illustrate the digestive pathway)*;

A2.7 demonstrate an understanding of visual indicators of health status that should be noted when carrying out a health assessment of an individual *(e.g., skin appearance [normal, bruised, jaundiced], breathing, posture, height, weight, alertness, balance, gait, signs of malnourishment)*.

A3. Homeostasis

By the end of this course, students will:

A3.1 identify the various balances that the body regulates in order to maintain a stable internal environment *(e.g., temperature, blood glucose, acid/base, sleep, blood pressure)*;

A3.2 identify factors that can create a homeostatic imbalance *(e.g., vomiting/diarrhea can lead to dehydration and electrolyte imbalance)*;

A3.3 explain how imbalances in body systems affect personal health *(e.g., an imbalance in blood glucose can lead to hypoglycemia/hyperglycemia)*.

A4. Lifestyle Choices

By the end of this course, students will:

A4.1 identify lifestyle choices that can improve a person's health and well-being *(e.g., avoidance of substance use/abuse, stress management, regular exercise, prevention of dental cavities, safe use of MP3 players and cell phones, using an Aboriginal medicine wheel as a health framework)*;

A4.2 assess a simulated client's dietary strengths and weaknesses and make appropriate food and nutrition suggestions, using appropriate resources *(e.g.,* Eating Well with Canada's Food Guide *[2007];* Eating Well with Canada's Food Guide: First Nations, Inuit and Métis; *cultural adaptations of Canada's Food Guide available from the Ontario Public Health Association)*;

A4.3 identify different types of community health and social services that help people maintain active and healthy lives *(e.g., community care access centres, nursing, mental health services, physiotherapy, lab services, Meals on Wheels, vision services, dental services, pharmacy services)*.

A5. Disease Prevention and Treatment

By the end of this course, students will:

A5.1 research and describe conventional methods of preventing and treating disease *(e.g., prescribed and over-the-counter medication, radiation treatment, chemotherapy, surgery, microscopic surgery, diet, lithotripsy)*;

A5.2 research and describe complementary methods of preventing and treating disease *(e.g., meditation, herbal remedies, massage therapy, acupuncture, First Nations ritual of smudging to purify and cleanse the body, energy healing)*;

A5.3 demonstrate an understanding of the chain of infection and the principles of infection control.

B. HEALTH CARE SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. use health care instruments, equipment, and materials safely and correctly;

B2. demonstrate the ability to use vital signs to determine a client's health status;

B3. demonstrate the ability to apply health care skills and techniques safely and to industry standards;

B4. demonstrate the ability to apply a variety of techniques for communicating with clients and collecting client information.

SPECIFIC EXPECTATIONS

B1. Instruments, Equipment, and Materials

By the end of this course, students will:

B1.1 identify common medical instruments *(e.g., sphygmomanometer, forceps, double-ended explorer)*, equipment *(e.g., Hoyer lift, intravenous [IV] pole, weigh scales, microscope, mouth mirror)*, and materials *(e.g., wound dressings, bed linens and lift sheets, gloves, protective gowns, eye shields)*, and use them safely and correctly;

B1.2 disinfect instruments, equipment, materials, and surfaces, using accepted medical aseptic procedures, to prevent the spread of infection;

B1.3 prepare, clean, and store instruments and equipment correctly, following standard industry procedures *(e.g., calibrate sphygmomanometer correctly prior to use, prepare instruments for autoclaving, clean pill cutter before and after use).*

B2. Vital Signs

By the end of this course, students will:

B2.1 demonstrate the ability to use equipment to measure vital signs (temperature, pulse, respiration, and blood pressure);

B2.2 assess and document a client's vital signs: temperature (by oral, axillary, and tympanic routes); pulse rate (rhythm and volume by apical and radial sites); respiration rate (rhythm and character); and blood pressure;

B2.3 identify normal values for temperature, pulse, respiration, and blood pressure across the lifespan, and assess possible health implications of abnormal values *(e.g., elevated temperature suggests a possible infection; an elevated blood pressure reading may be an early indication of hypertension).*

B3. Skills and Techniques

By the end of this course, students will:

B3.1 demonstrate an understanding of correct hand hygiene procedures *(e.g., knowing when they are required, knowing when to use hand washing rather than antibacterial sanitizers)*, and apply as required;

B3.2 perform common caregiving skills and techniques *(e.g., bed making, bed bathing, feeding, toileting, oral care, weighing)* safely and correctly, using baby and/or adult mannequins;

B3.3 perform mobility techniques *(e.g., turning, lifting, and transferring clients; using crutches or walkers and instructing clients in their use)* safely and correctly;

B3.4 perform a range of motion and positioning techniques safely and correctly to prevent the development of decubitus ulcers and contractures in clients;

B3.5 demonstrate an understanding of *(e.g., through role play)* and apply health and safety procedures relating to proper body mechanics and ergonomics *(e.g., base of support, good body posture)*;

B3.6 demonstrate an understanding of and apply safe practices for handling, preparing, and storing food in a real or simulated care environment *(e.g., use proper cooking temperatures to kill bacteria; check that clients' food tolerances, requirements, or restrictions are observed).*

B4. Communication and Documentation

By the end of this course, students will:

B4.1 demonstrate the ability to use basic therapeutic communication techniques *(e.g., active listening and paraphrasing)*;

B4.2 identify various communication barriers *(e.g., barriers relating to health conditions, age, stage of development, and differing cultural communication styles)*, and apply strategies for overcoming them;

B4.3 demonstrate competence in the use of methods for collecting client data *(e.g., interviews, questionnaires)* and documenting client information.

C. HEALTH CARE, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. describe the impact of health care industry activities on the environment and identify ways of minimizing their harmful consequences;

C2. describe the impact of current social patterns and trends on personal health and the delivery of health care.

SPECIFIC EXPECTATIONS

C1. Health Care and the Environment

By the end of this course, students will:

C1.1 describe the potential impact on the environment of biohazardous wastes from health care facilities *(e.g., body fluid and human tissue, sharps containing bacteria or viruses)*;

C1.2 identify safe methods for the handling, storage, and disposal of wastes and biohazardous materials *(e.g., use of checklists, sharps containers, double wrapping, proper labelling)*;

C1.3 describe good environmental practices that can be applied in the health care industry *(e.g., using energy-efficient lighting; reducing, reusing, or recycling packaging material; storing information electronically instead of on paper)*.

C2. Health Care and Society

By the end of this course, students will:

C2.1 identify demographic and lifestyle patterns and trends *(e.g., an aging population, lack of exercise)* and describe their implications for the health care industry *(e.g., increased obesity and susceptibility to diabetes and cardiovascular disease, changes in care needs, changes in treatments and interventions, trends in mental illness and public attitudes towards it)*;

C2.2 explain the relationship between socio-economic status and health *(e.g., differences in various health parameters among children aged 4 to 6 from different socio-economic backgrounds)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and comply with safe working practices and the laws and regulations governing the health and safety of workers in the health care industry;

D2. demonstrate an understanding of legal and ethical standards governing the practice of health care;

D3. describe career opportunities in the health care field and related educational requirements.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify and comply with legislation, regulations, standards, and requirements pertaining to worker safety in the health care workplace (*e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS]*);

D1.2 demonstrate an understanding of and apply safe procedures for the use of tools and equipment as outlined in safety manuals, operating instructions, and institutional requirements;

D1.3 use protective clothing and equipment as required to keep themselves and others safe and free from harm.

D2. Professional Standards

By the end of this course, students will:

D2.1 identify and explain the principal components of legislation pertaining to health care in Ontario (*e.g., Regulated Health Professions Act [RHPA] sets the framework for regulating the scope of practice of health professions*);

D2.2 describe the professional and ethical standards that health care workers are expected to adhere to (*e.g., accountability, knowledge, competence, respect for patients' rights and privacy, respect for cultural and religious diversity, respect for the sanctity of life*).

D3. Career Opportunities

By the end of this course, students will:

D3.1 identify career opportunities in health care and describe the education and/or training required for entry into these occupations;

D3.2 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the health care industry (*e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations*);

D3.3 demonstrate an understanding of and apply the Essential Skills that are important for success in the health care industry, as identified in the Ontario Skills Passport (*e.g., document use, decision making, finding information*);

D3.4 demonstrate an understanding of and apply the work habits that are important for success in the health care industry, as identified in the Ontario Skills Passport (*e.g., working safely, teamwork, reliability*);

D3.5 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in health care (*e.g., Passport to Safety certificate, reports, assignments, Ontario Skills Passport Work Plan*), and explain why having a current portfolio is important for career development and advancement.

Health Care, Grade 12

University/College Preparation TPJ4M

This course focuses on the development of a range of skills needed to analyse and interpret clinical findings. Students will learn about accepted health care practices and demonstrate an understanding of basic procedures and the use of appropriate instruments and equipment. They will acquire an understanding of basic concepts related to the function of the human immune system and explore the relationship between pathology and disease prevention and treatment. Students will expand their awareness of workers' health and safety issues, analyse environmental and societal issues related to health care, and further explore professional practice standards and postsecondary destinations in the field.

Prerequisite: Health Care, Grade 11, University/College Preparation

A. HEALTH CARE FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of health care terminology and its correct usage;

A2. demonstrate an understanding of the structure and functioning of the immune system;

A3. demonstrate an understanding of fundamental concepts in pathology and their application to the diagnosis and treatment of disease;

A4. demonstrate an understanding of the transmission of disease and methods of preventing it.

SPECIFIC EXPECTATIONS

A1. Health Care Terminology

By the end of this course, students will:

A1.1 demonstrate an understanding of correct terminology for equipment, instruments, and procedures *(e.g., vacutainer blood tube, electrocardiogram, culture tubes/slides, tri-flo syringe, otoscope, magnetic resonance imaging [MRI])*, and use it correctly in oral and written communication;

A1.2 demonstrate an understanding of medical terminology used in vital sign analysis *(e.g., febrile, auscultate, antecubital space, tachypnea, inflammation)*, and use it correctly in oral and written communication;

A1.3 identify and use medical abbreviations correctly *(e.g., MI [myocardial infarction], bid [two times per day/bis in die])*.

A2. The Immune System

By the end of this course, students will:

A2.1 demonstrate a basic understanding of the anatomy and physiology of the immune system *(e.g., location and function of bone marrow, thymus gland, lymph nodes, spleen; role of white blood cells and antibodies in response to pathogens and antigens)*;

A2.2 describe in detail the signs and symptoms of inflammation;

A2.3 describe the signs and symptoms of common immune disorders *(e.g., lupus, rheumatoid arthritis, chronic fatigue syndrome)*, and identify through research possible treatment strategies.

A3. Pathology

By the end of this course, students will:

A3.1 explain how microorganisms cause disease, and identify factors that affect the development of a disease *(e.g., bacterial growth requirements, virulence)*;

A3.2 analyse the life cycle of microorganisms and their impact on health care;

A3.3 explain how microorganisms are classified *(e.g., as bacteria, fungi, viruses, parasites)*;

A3.4 describe causes of various infectious diseases *(e.g., middle ear infections are caused by bacteria, viruses, or allergies)*, and describe the symptoms related to each *(e.g., elevated temperature, inflammation, pain)*;

A3.5 analyse how pathogens can affect multiple body systems *(e.g., streptococcus causes strep throat and can move to the heart, kidneys, and joints; ruptured appendicitis can cause peritonitis, septicemia, and death; dental bacteria can cause cavities and heart disease)*;

A3.6 describe abnormal values for each type of vital sign, and identify possible causes and appropriate interventions for each of these values *(e.g., elevated temperature can be caused by gram-positive cocci and may require antibiotic treatment)*;

A3.7 describe common diagnostic methods for identifying diseases *(e.g., urinalysis, complete blood count, X-rays, scans)*.

A4. Disease Prevention and Treatment

By the end of this course, students will:

A4.1 demonstrate an understanding of disease transmission *(e.g., the chain of infection)* and the role of the health care provider in health promotion and in controlling the spread of infection *(e.g., taking standard infection control precautions, such as following hand hygiene rules, sterilizing instruments and equipment, and keeping client areas clean)*;

A4.2 identify and describe characteristics of various disease outbreaks *(e.g., outbreaks of methicillin-resistant staphylococcus aureus [MRSA], C. difficile, severe acute respiratory syndrome [SARS], avian flu)*;

A4.3 identify methods of dealing with the outbreak of a disease using the chain of infection *(e.g., isolation protocols)*;

A4.4 describe common procedures and strategies for the prevention or early detection of disease *(e.g., good dental hygiene, health screening procedures such as Pap smears, examinations such as self-breast examination (SBE), immunizations such as chicken pox and hepatitis A/B vaccinations)*;

A4.5 demonstrate an understanding of Rh and ABO blood types and describe how incompatibility issues in blood transfusion *(e.g., fetal Rh incompatibility)* can be avoided;

A4.6 identify examples of the misuse of antibiotics and antibacterial substances *(e.g., in household products)* and describe the consequences *(e.g., antibiotic resistance, superbugs)*.

B. HEALTH CARE SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. demonstrate competence in using health care instruments, equipment, and materials;

B2. demonstrate the ability to use vital signs to determine a client's health status;

B3. demonstrate an understanding of and apply standard practices and procedures used in the health care field;

B4. demonstrate an understanding of and apply communication and documentation techniques required in the health care industry.

SPECIFIC EXPECTATIONS

B1. Instruments, Equipment, and Materials

By the end of this course, students will:

B1.1 identify a wide range of tools, equipment, and materials used in the health care industry (*e.g., forceps, sterile dressing trays/packages, centrifuges, autoclaves, reagent strips, glucometers, containers for culture and sensitivity testing*), and use them safely and correctly;

B1.2 prepare, clean, and store instruments, equipment, and materials, following standard industry procedures (*e.g., follow standard medical and surgical aseptic procedures while handling equipment such as stethoscopes, thermometers, and scalers*).

B2. Vital Signs

By the end of this course, students will:

B2.1 demonstrate the ability to use equipment to measure the four primary vital signs (temperature, pulse, respiration, blood pressure) and to assess the degree of pain (often considered an additional vital sign);

B2.2 assess and document a client's vital signs: temperature (by oral, axillary, and tympanic routes), pulse rate (rhythm and volume), respiration rate (rhythm and character), blood pressure, and pain intensity (*e.g., using a pain scale*);

B2.3 identify normal values for temperature, pulse, respiration, blood pressure, and pain intensity

across the lifespan, and assess possible health implications of abnormal values (*e.g., elevated temperature suggests a possible infection; an elevated blood pressure reading may be an early indication of hypertension*).

B3. Practices and Procedures

By the end of this course, students will:

B3.1 demonstrate an understanding of (*e.g., through role play*) and apply standard first-aid (SFA) and cardiopulmonary resuscitation (CPR) procedures (*e.g., emergency scene management; control of bleeding; treatment of sprains, fractures, burns, loss of consciousness, anaphylactic reaction/shock, choking*);

B3.2 use appropriate medical aseptic procedures (*e.g., hand hygiene, gloving, proper use of biohazard waste containers and handling of contaminated laundry waste, steam sterilization of equipment*) to prevent the spread of pathogens;

B3.3 use appropriate precautions when handling body substances, as demonstrated through role play and the use of simulated body products (*e.g., blood products, body fluids, human tissue, and materials contaminated with these substances*);

B3.4 demonstrate an understanding of and apply standard industry procedures for handling specimens and administering medications and treatments (*e.g., safely collect, label, store, and transport specimens to prevent contamination and degradation of sample; correctly dispense mock medication following the College of Nurses of*

Ontario [CNO] rights of medication administration standards [right time, right client, right medication, right reason, right dose, right frequency, right route, right site, right documentation]; administer heat and cold applications as appropriate);

B3.5 analyse and interpret findings from simulated client information *(e.g., use case studies to complete a history, identify symptoms, determine a diagnosis, and prepare a treatment plan).*

B4. Communication and Documentation

By the end of this course, students will:

B4.1 demonstrate an understanding of and apply effective therapeutic communication techniques *(e.g., active listening, paraphrasing, use of culturally responsive communication techniques)* in a variety of situations;

B4.2 collect pertinent information in a simulated patient care situation and report patient care data on the appropriate forms *(e.g., flow charts, graphic charts such as vital signs records, dental charts);*

B4.3 assess communication challenges related to cultural and religious diiversity *(e.g., the need to respect religious beliefs such as those that preclude blood transfusions and after-death care, and cultural beliefs related to child-birth and pain management or to the care of female patients by male doctors or nurses),* and apply strategies for addressing them.

C. HEALTH CARE, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. assess the impact of the health care industry on the environment, and identify legal requirements and guidelines for protecting the environment from harmful consequences;

C2. assess the societal and ethical implications of advances in medical technology.

SPECIFIC EXPECTATIONS

C1. Health Care and the Environment

By the end of this course, students will:

C1.1 describe the environmental impact of technological advances in the health care field (*e.g., single-use devices create end disposal issues, as incineration results in heavy metal toxicity and landfilling creates biohazardous leachate; because of the increased use of pharmaceuticals, traces of prescription drugs are now being found in surface water*);

C1.2 research and report on laws, regulations, guidelines, and information sources pertaining to the disposal of medical waste (*e.g., Atomic Energy Control Board – radioactive materials; Workplace Hazardous Materials Information System [WHMIS] – chemical hazards*);

C1.3 identify some environmental impacts of a health care product over its complete life cycle (*e.g., use of harmful chemicals in manufacturing the product, energy consumption for manufacturing and transportation of raw materials and completed products, packaging waste, impact of the product when disposed of, impact of drug residues in human body wastes*).

C2. Health Care and Society

By the end of this course, students will:

C2.1 analyse ethical issues related to various products and procedures that have contributed to improved health care (*e.g., life-extending devices such as cardiac pacemakers and internal defibrillators, microscopic/robotic surgical procedures; priorities for organ transplants*);

C2.2 assess the impact of medical biotechnology (*e.g., in vitro fertilization [IVF], chorionic villus sampling [CVS], umbilical cord blood storage*) on people's everyday lives;

C2.3 identify and report on bioethical issues in health care (*e.g., right to refuse treatment, euthanasia, stem cell research*).

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and comply with safe working practices and the laws and regulations governing the health and safety of workers in the health care industry;

D2. demonstrate an understanding of legal, ethical, and professional standards governing the practice of health care;

D3. demonstrate an understanding of the range of career opportunities in conventional and alternative therapy fields.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 explain the principal components of and comply with legislation, regulations, and guidelines pertaining to the safety of the health care workplace (*e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS]*);

D1.2 identify potential hazards in the health care workplace (*e.g., biological, chemical, radiological, and physical hazards such as body fluids, soiled linens, cleaning agents, X-rays, combative clients, and sharp objects*);

D1.3 assess various workplace factors that may lead to short-term or long-term health and safety issues for health care workers (*e.g., long hours on feet, long work shifts, lifting/moving of patients, ergonomic considerations*);

D1.4 demonstrate an understanding of and apply safe procedures for the use of instruments, materials, and equipment as outlined in safety manuals, operating instructions, and institutional requirements;

D1.5 use protective clothing and equipment as required to keep themselves and others safe and free from harm.

D2. Professional Standards

By the end of this course, students will:

D2.1 explain the principal components of legislation regulating the practice of health care in Ontario (*e.g., Regulated Health Professions Act [RHPA] sets the framework for regulating the scope of practice of health professions*);

D2.2 assess malpractice and other liability issues (*e.g., termination of care, negligence, misuse of controlled substances, misuse of power of attorney*);

D2.3 identify the governing bodies for various health care professions (*e.g., College of Nurses of Ontario, College of Physicians and Surgeons, College of Dentistry*) and explain their roles and responsibilities;

D2.4 identify the steps involved in reporting professional misconduct to a professional governing body or college (*e.g., College of Physicians and Surgeons, College of Nurses of Ontario, College of Dentistry*) and describe possible outcomes (*e.g., suspension, loss of licence, retraining*);

D2.5 demonstrate an understanding of the importance of maintaining client confidentiality, and explain the obligations of health care providers under the Personal Health Information Act for ensuring client privacy and confidentiality (*e.g., requirements regarding the collection, use, retention, disclosure, and disposal of client information, such as diagnostic test results or HIV status*);

D2.6 demonstrate an understanding of how medical knowledge is advanced *(e.g., biological research, epidemiological research, drug research and trials, accumulated experience)*, and identify ways in which individuals can keep abreast of advancing medical knowledge *(e.g., reading journal articles, attending seminars and workshops, receiving in-service training)*.

D3. Career Opportunities

By the end of this course, students will:

D3.1 assess health care career opportunities in conventional and alternative therapy fields and describe the education and/or training required for a specific career path;

D3.2 demonstrate an understanding of and apply the Essential Skills that are important for success in the health care industry, as identified in the Ontario Skills Passport *(e.g., computer use, data analysis, job task planning and organizing)*;

D3.3 demonstrate an understanding of and apply the work habits that are important for success in the health care industry, as identified in the Ontario Skills Passport *(e.g., teamwork, organization, self-advocacy)*;

D3.4 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in health care *(e.g., Passport to Safety certificate, reports, assignments, Ontario Skills Passport Work Plan and Transition Plan)*, and explain why having a current portfolio is important for career development and advancement.

Health Care, Grade 12

College Preparation

TPJ4C

This course focuses on the development of clinical skills needed to assess general health status. Students will learn about accepted health care practices and demonstrate an understanding of some basic procedures and the use of appropriate instruments and equipment. They will identify the characteristics of the human immune system and learn about pathology and disease prevention and treatment. Students will expand their awareness of workers' health and safety issues, environmental and societal issues related to health care, professional practice standards, and postsecondary destinations in the field.

Prerequisite: Health Care, Grade 11, College Preparation

A. HEALTH CARE FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of health care terminology and its correct usage;

A2. demonstrate an understanding of the structure and functioning of the immune system;

A3. demonstrate an understanding of fundamental concepts in pathology and their application to the diagnosis and treatment of disease;

A4. demonstrate an understanding of the transmission of disease and methods of preventing it.

SPECIFIC EXPECTATIONS

A1. Health Care Terminology

By the end of this course, students will:

A1.1 demonstrate an understanding of correct terminology for equipment, instruments, and procedures *(e.g., evacuated blood tube, electrocardiogram, spirometer, culture tubes/slides, triflow syringe, otoscope, magnetic resonance imaging [MRI])*, and use it correctly in oral and written communication;

A1.2 demonstrate an understanding of medical terminology used in vital sign analysis *(e.g., febrile, auscultate, antecubital space, tachypnea, inflammation)*, and use it correctly in oral and written communication;

A1.3 pronounce and spell key health care terms correctly *(e.g., proximal = prox-ih-mahl)*.

A2. The Immune System

By the end of this course, students will:

A2.1 demonstrate a basic understanding of the anatomy and physiology of the immune system *(e.g., location and function of bone marrow, thymus gland, lymph nodes, spleen; role of white blood cells and antibodies in response to pathogens and antigens)*;

A2.2 describe the signs and symptoms of inflammation;

A2.3 describe the signs and symptoms of common immune disorders *(e.g., lupus, rheumatoid arthritis, chronic fatigue syndrome)*.

A3. Pathology

By the end of this course, students will:

A3.1 explain how microorganisms cause disease, and identify factors that affect the development of a disease *(e.g., bacterial growth requirements, virulence)*;

A3.2 identify causes of various infectious diseases *(e.g., middle ear infections are caused by bacteria [gram-positive cocci]; heart disease can be caused by dental bacteria)*, and describe the symptoms related to each *(e.g., elevated temperature, inflammation)*;

A3.3 describe abnormal values for each type of vital sign, and identify appropriate interventions for each of these values *(e.g., elevated temperature requires that other presenting symptoms be assessed, recorded, and reported to a physician and appropriate medication administered if needed; increased respiratory rate with shortness of breath may require only elevation of the head of the bed and administration of oxygen)*;

A3.4 describe common diagnostic methods for identifying diseases *(e.g., urinalysis, complete blood count, X-rays, scans)*.

A4. Disease Prevention and Treatment

By the end of this course, students will:

A4.1 demonstrate a basic understanding of disease transmission *(e.g., the chain of infection)* and the role of the health care provider in controlling the spread of infection *(e.g., taking*

standard infection control precautions, such as following hand hygiene rules, sterilizing instruments and equipment, and keeping client areas clean);

A4.2 identify common disease-control problems in health care facilities, and describe possible responses and the resources needed to implement them *(e.g., an outbreak of methicillin resistant staphylococcus aureus [MRSA] requires a plan of isolation for the client);*

A4.3 identify common procedures and strategies for the prevention or early detection of disease *(e.g., good dental hygiene, health screening procedures such as Pap smears, examinations such as self-breast examination (SBE), and immunizations such as chicken pox vaccinations);*

A4.4 explain reasons for the emergence of antibiotic-resistant strains of microorganisms *(e.g., the overuse of antibiotics and antibacterial cleansers),* and describe their impact on health care facilities and the methods needed to control them.

B. HEALTH CARE SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. demonstrate competence in using health care instruments, equipment, and materials;

B2. demonstrate the ability to use vital signs to determine a client's health status;

B3. demonstrate an understanding of and apply standard practices and procedures used in the health care field;

B4. demonstrate an understanding of and apply communication and documentation techniques required in the health care industry.

SPECIFIC EXPECTATIONS

B1. Instruments, Equipment, and Materials

By the end of this course, students will:

B1.1 identify common instruments, equipment, and materials used in the health care industry *(e.g., forceps, sterile dressing trays/packages, centrifuges, autoclaves, reagent strips, glucometers, containers for culture and sensitivity testing)*, and use them safely and correctly;

B1.2 prepare, clean, and store instruments, equipment, and materials, following standard industry procedures *(e.g., follow standard medical and surgical aseptic procedures while handling equipment such as stethoscopes, thermometers, and scalers)*.

B2. Vital Signs

By the end of this course, students will:

B2.1 demonstrate the ability to measure the four primary vital signs (temperature, pulse, respiration, blood pressure) and to assess the degree of pain (often considered an additional vital sign);

B2.2 assess and document a client's vital signs: temperature (by oral, axillary, and tympanic routes), pulse rate (rhythm and volume), respiration rate (rhythm and character), blood pressure, and pain intensity *(e.g., using a pain scale)*;

B2.3 identify normal values for temperature, pulse, respiration, blood pressure, and pain

intensity across the lifespan, and assess possible health implications of abnormal values *(e.g., elevated temperature suggests a possible infection; an elevated blood pressure reading may be an early indication of hypertension)*.

B3. Practices and Procedures

By the end of this course, students will:

B3.1 demonstrate an understanding of *(e.g., through role play)* and apply standard first-aid (SFA) and cardiopulmonary resuscitation (CPR) procedures *(e.g., emergency scene management; control of bleeding; treatment of sprains, fractures, burns, loss of consciousness, anaphylactic reaction/shock, choking)*;

B3.2 use appropriate medical aseptic procedures *(e.g., hand hygiene, gloving, proper use of biohazard waste containers, safe handling of contaminated laundry waste)* to prevent the spread of pathogens;

B3.3 use appropriate precautions when handling body substances, as demonstrated through role play and the use of simulated body products *(e.g., blood products, body fluids, human tissue, and materials contaminated with these substances)*;

B3.4 demonstrate an understanding of and apply standard industry procedures for handling specimens and administering medications and treatments *(e.g., safely collect, label, store, and transport specimens to prevent contamination and degradation of sample; correctly dispense mock medication following the College of Nurses of

Ontario [CNO] rights of medication administration standards [right time, right client, right medication, right reason, right dose, right frequency, right route, right site, right documentation]; administer heat and cold applications as appropriate);

B3.5 assess simulated client information and prepare findings *(e.g., use case studies to complete a history, identify symptoms, determine a diagnosis, and prepare a treatment plan).*

B4. Communication and Documentation

By the end of this course, students will:

B4.1 demonstrate an understanding of and apply effective therapeutic communication techniques *(e.g., active listening, paraphrasing, adaptation to cultural barriers);*

B4.2 collect pertinent information in a simulated patient care situation and report patient care data on the appropriate forms *(e.g., flow charts, graphic charts such as vital signs records, dental charts);*

B4.3 describe communication challenges related to cultural and religious diversity *(e.g., language barriers, avoidance of eye contact, religious beliefs such as those that preclude blood transfusions and after-death care, cultural beliefs related to childbirth and pain management or to the care of female patients by male doctors or nurses),* and apply strategies for addressing them.

C. HEALTH CARE, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. describe the impact of the health care industry on the environment, and identify legal requirements and guidelines for protecting the environment from harmful consequences;

C2. describe the societal and ethical implications of advances in medical technology.

SPECIFIC EXPECTATIONS

C1. Health Care and the Environment

By the end of this course, students will:

C1.1 identify the environmental impact of technological advances in the health care field (*e.g., single-use devices create end disposal issues, as incineration results in heavy metal toxicity and landfilling creates biohazardous leachate; because of the increased use of pharmaceuticals, traces of prescription drugs are now being found in surface water*);

C1.2 research and report on laws, regulations, guidelines, and information sources pertaining to the disposal of medical waste (*e.g., Atomic Energy Control Board – radioactive materials; Workplace Hazardous Materials Information System [WHMIS] – chemical hazards; Ontario Regulation 102/94 – waste management*);

C1.3 identify some environmental impacts of a health care product over its complete life cycle (*e.g., use of harmful chemicals in manufacturing the product, energy consumption for manufacturing and transportation of raw materials and completed products, packaging waste, impact of the product when disposed of, impact of drug residues in human body wastes*).

C2. Health Care and Society

By the end of this course, students will:

C2.1 describe ethical issues related to various products and procedures that have contributed to improved health care (*e.g., life-extending devices such as cardiac pacemakers and internal defibrillators, microscopic/robotic surgical procedures; priorities for organ transplants*);

C2.2 describe the impact of medical biotechnology (*e.g., in vitro fertilization [IVF], chorionic villus sampling [CVS], umbilical cord blood storage*) on people's everyday lives.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and comply with safe working practices and the laws and regulations governing health and safety standards for workers in the health care industry;

D2. demonstrate an understanding of legal, ethical, and professional standards governing the practice of health care;

D3. demonstrate an understanding of career opportunities in conventional and alternative therapy fields.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 describe the principal components of and comply with legislation, regulations, and guidelines pertaining to the safety of the health care workplace *(e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS])*;

D1.2 identify potential hazards in the health care workplace *(e.g., biological, chemical, radiological, and physical hazards such as body fluids, soiled linens, cleaning agents, X-rays, combative clients, and sharp objects)*;

D1.3 identify workplace factors that may lead to short-term or long-term health and safety issues for health care workers *(e.g., long hours on feet, long work shifts, lifting/moving of patients, ergonomic considerations)*;

D1.4 demonstrate an understanding of and apply safe procedures for the use of instruments, materials, and equipment as outlined in safety manuals, operating instructions, and institutional requirements;

D1.5 use protective clothing and equipment as required to keep themselves and others safe and free from harm.

D2. Professional Standards

By the end of this course, students will:

D2.1 identify and explain the principal components of legislation regulating the practice of health care in Ontario *(e.g., Regulated Health Professions Act [RHPA] sets the framework for regulating the scope of practice of health professions)*;

D2.2 describe malpractice and other liability issues *(e.g., termination of care, negligence, theft or misuse of controlled substances, mismanagement of power of attorney)*;

D2.3 identify the governing bodies for various health care professions *(e.g., College of Nurses of Ontario, College of Physicians and Surgeons, College of Dentistry)*, and describe their roles and responsibilities;

D2.4 identify the steps involved in reporting professional misconduct to a professional governing body or college *(e.g., College of Physicians and Surgeons, College of Nurses of Ontario, College of Dentistry)*;

D2.5 demonstrate an understanding of the importance of maintaining client confidentiality, and explain the obligations of health care providers under the Personal Health Information Act for ensuring client privacy and confidentiality *(e.g., requirements regarding the collection, use, retention, disclosure, and disposal of client information, such as diagnostic test results or HIV status)*;

D2.6 demonstrate an understanding of how medical knowledge is advanced *(e.g., biological research, epidemiological research, drug research and trials, accumulated experience)*, and identify ways in which individuals can keep abreast of advancing medical knowledge *(e.g., reading journal articles, attending seminars and workshops, receiving in-service training)*.

D3. Career Opportunities

By the end of this course, students will:

D3.1 describe health care career opportunities in conventional and alternative therapy fields and the education and/or training required for a specific career path;

D3.2 demonstrate an understanding of and apply the Essential Skills that are important for success in the health care industry, as identified in the Ontario Skills Passport *(e.g., computer use, data analysis, job task planning and organizing)*;

D3.3 demonstrate an understanding of and apply the work habits that are important for success in the health care industry, as identified in the Ontario Skills Passport *(e.g., teamwork, organization, self-advocacy)*;

D3.4 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in health care *(e.g., Passport to Safety certificate, reports, assignments, Ontario Skills Passport Work Plan and Transition Plan)*, and explain why having a current portfolio is important for career development and advancement.

Child Development and Gerontology, Grade 12

College Preparation   TOJ4C

This course enables students to examine the stages of child development and the aging process. Students will study the processes of disease and factors contributing to health and well-being in early and later life, and will develop skills required to meet the needs of children and older adults (care skills). Students will also learn about legislation governing the care of children and older adults; evaluate social and recreational activities, programs, and services for improving quality of life; and develop an awareness of health and safety issues, environmental and social issues, and career opportunities related to child care and gerontology.

Prerequisite: None

Note: Although this course may be delivered as an emphasis course focusing on *either* child development *or* gerontology (see p. 17), many schools will deliver it as a broad-based course covering both areas, as represented in this document. The expectations that follow outline a full and extensive range of knowledge and skills pertaining to both areas equally, and include distinct examples, wherever possible, for each area. It is recognized that a one-credit course may not afford the time necessary for thorough and complete coverage of all aspects of every expectation for each of the two areas. Teachers delivering the course should use their professional judgement in determining which area will be the focus of learning in connection with selected specific expectations.

A. CHILD DEVELOPMENT AND GERONTOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of the stages of child development and of the aging process in older adults;

A2. identify common diseases and illnesses that affect children and older adults, and explain how their occurrence or transmission can be prevented;

A3. demonstrate an understanding of factors that contribute to the overall health and well-being of children and older adults;

A4. describe various community health and social services for children and older adults;

A5. describe the final stages of life, grieving, and the ways in which children and older adults may experience loss;

A6. identify various forms of abuse to which children and older adults may be subjected, and describe how society tries to prevent abuse and protect its victims.

SPECIFIC EXPECTATIONS

A1. Stages of Development and Aging

By the end of this course, students will:

A1.1 describe and compare theories of child development (*e.g., the theories of Erikson, Freud, Piaget, Vygotsky*);

A1.2 describe physical and psychological changes associated with the normal aging process in older adults (*e.g., skin and hair changes, slowed tissue repair, reduced mobility, gradual sensory impairment; in some cases, a sense of isolation or diminished self-worth*);

A1.3 identify and assess common myths and false assumptions about early childhood development and the aging process in older adults (*e.g., an infant brain is poorly developed at birth; older adults are unable to learn new skills*).

A2. Diseases and Illness Prevention

By the end of this course, students will:

A2.1 identify and describe, on the basis of research, common diseases and illnesses affecting children at different stages of development (*e.g., newborn: thrush; preschool: conjunctivitis;*

school age: chicken pox) and older adults (*e.g., illnesses associated with aging: Alzheimer's disease, arthritis, heart failure, stroke; infectious diseases: pneumonia, influenza*);

A2.2 demonstrate appropriate hand hygiene techniques and explain the importance of hand washing to prevent disease transmission;

A2.3 explain the importance of routine hygienic practices to prevent the transmission of disease (*e.g., proper disposal of diapers or incontinence products, changing and handling of bed linens*);

A2.4 explain the difference between active and passive immunity, and describe how these two types of immunity are acquired;

A2.5 explain the importance of immunization in preventing the occurrence or spread of disease;

A2.6 summarize, on the basis of research, the recommended vaccination protocol in Ontario (*e.g., vaccination against measles, mumps, and rubella [MMR]; diphtheria, pertussis, and tetanus [DPT]; influenza; meningitis; pneumococcal infections; varicella*) and explain the pros and cons of immunization programs from various perspectives (*e.g., personal, societal, religious, cultural, legal*).

A3. Health and Well-Being

By the end of this course, students will:

A3.1 identify the areas of human life and experience that, taken together, determine overall health and well-being *(e.g., physical, psychological, social-emotional, cognitive, spiritual)*;

A3.2 describe Maslow's hierarchy of needs theory and explain how it applies to the well-being of children at different stages of development and of older adults;

A3.3 explain the benefits of good nutrition and well-balanced meals to overall health and well-being, in relation to age and stage of development;

A3.4 explain the benefits of exercise to overall health and well-being, in relation to age and stage of development;

A3.5 explain the importance of social interaction and cognitive stimulation to overall well-being, in relation to age and stage of development *(e.g., to promote cognitive development in young children and to protect against cognitive decline in older adults; to promote a sense of self-worth, connection, and relevance and thus combat depression in older adults)*.

A4. Community Health and Social Services

By the end of this course, students will:

A4.1 describe, on the basis of research, various community and public health programs and services that focus on the physical, psychological, cognitive, spiritual, and/or social well-being of children and older adults *(e.g., day care, early learning centres, Aboriginal Head Start programs, public library programs; elder hostels, senior day programs, Aboriginal elder programs, church programs; in-home services provided through the Ontario Association of Community Care Access Centres)*;

A4.2 describe various products provided through public health services to enhance the quality of life of children and older adults and their families *(e.g., assistive devices, nutritional supplements)*.

A5. The Final Stages of Life and the Impact of Loss

By the end of this course, students will:

A5.1 demonstrate an understanding of the concept of death and describe the five-stage process of coming to terms with death and dying, as conceived by Elisabeth Kübler-Ross (i.e., denial, anger, bargaining, depression, acceptance);

A5.2 describe the physical signs of approaching death *(e.g., decreased circulation, apnea, Cheyne-Stokes respiration)*;

A5.3 describe the clinical indicators of death *(e.g., absent vital signs, fixed and dilated pupils)*;

A5.4 describe some of the different religious and cultural beliefs and practices related to death and dying, the arrangements that typically need to be made in connection with funeral or other ceremonial proceedings, and how financial considerations may affect these practices;

A5.5 describe various types of loss and how they may be experienced by children at different stages of development and by older adults *(e.g., loss of a pet, separation from a parent as a result of divorce, loss of a body part, loss of peers at an increasing rate in old age)*.

A6. Abuse

By the end of this course, students will:

A6.1 demonstrate an understanding of the various forms of abuse experienced by children and older adults *(e.g., physical, emotional, verbal, financial)*;

A6.2 identify government legislation, regulations, and standards that establish procedures for the prevention of injuries to and neglect of children *(e.g., Child and Family Services Act, Child Protection Standards in Ontario)* and agencies and organizations dedicated to the protection of children's rights and safety *(e.g., Children's Aid Society [CAS], Catholic Children's Aid Society [CCAS])*;

A6.3 identify organizations dedicated to the prevention of elder abuse and the protection and treatment of its victims *(e.g., Ontario Network for the Prevention of Elder Abuse [ONPEA], Canadian Network for the Prevention of Elder Abuse [CNPEA], Advocacy Centre for the Elderly [ACE])*.

B. CHILD DEVELOPMENT AND GERONTOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. create appropriate meal plans to enhance the well-being of children and older adults;

B2. design appropriate physical activity programs to enhance the well-being of children and older adults;

B3. devise approaches to meet the social-emotional and cognitive needs of children and older adults;

B4. demonstrate appropriate use of techniques and practices required to assess and meet the physical needs of children and older adults;

B5. demonstrate the ability to communicate effectively with children at various stages of development and with older adults when providing health care and/or social services.

SPECIFIC EXPECTATIONS

B1. Meeting Nutritional Needs

By the end of this course, students will:

B1.1 summarize information about the essential nutrients *(e.g., create a chart listing the sources and functions of essential nutrients)* and explain their importance in a balanced diet for children and older adults;

B1.2 design an appropriate meal plan for a child and an older adult, using relevant resources *(e.g.,* Eating Well with Canada's Food Guide *[2007],* Eating Well with Canada's Food Guide: First Nations, Inuit and Métis; *cultural adaptations of Canada's Food Guide available from the Ontario Public Health Association)*;

B1.3 design a meal plan that addresses the nutritional needs of clients who have special dietary requirements because of health-related problems *(e.g., heart disease, diabetes, allergies or intolerances)*, physical limitations *(e.g., resulting from arthritis)*, and/or religious or cultural background.

B2. Meeting the Need for Physical Activity

By the end of this course, students will:

B2.1 describe the basic components of an appropriate daily physical fitness/activity routine *(e.g., including outdoor play experience, warm-up/cool-down, stretching, cardio [aerobic] exercise, strength training)*;

B2.2 design a safe physical activity or program appropriate to the particular stage of development and/or physical condition of a child and an older adult *(e.g., in terms of activity type and level [tolerance], duration, use of equipment)*.

B3. Meeting Cognitive and Social-Emotional Needs

By the end of this course, students will:

B3.1 describe and conduct a range of appropriate and stimulating activities and games to promote the cognitive and social-emotional well-being of children at various stages of development *(e.g., sort and compare shapes, word games)* and of older adults experiencing various effects of aging *(e.g., sports, baking, book groups, discussion circles in which reminiscence or life review is encouraged)*;

B3.2 evaluate the suitability of a variety of toys, occupational therapy devices, and recreational equipment *(e.g., in terms of appropriate materials, safety of detachable parts, ease of handling, ability to provide sensory stimulation)* for children at various stages of development and for older adults experiencing various effects of aging;

B3.3 describe and apply appropriate approaches and activities to promote the cognitive and social-emotional well-being of children and older adults with particular health problems *(e.g., impaired vision, physical challenges, hearing loss)*, including mental health problems *(e.g., attention deficit disorder, autism spectrum disorders, depression, bipolar disorder, Alzheimer's disease)*;

B3.4 select, on the basis of research, and conduct intergenerational activities *(e.g., storytelling, career exploration)* designed to promote the cognitive and social-emotional well-being of both children and older adults.

B4. Care Techniques and Practices

By the end of this course, students will:

B4.1 use correct techniques for taking care of children and older adults *(e.g., when feeding, bathing, lifting and transferring, toileting, and providing skin care such as washing, drying, and applying protective skin products)*;

B4.2 demonstrate the correct use of ambulation devices used by children and older adults *(e.g., wheelchairs, walkers, canes)*;

B4.3 perform vital sign measurements (i.e., temperature, blood pressure, pulse rate, respiration rate) in children and older adults, and analyse findings in relation to normal values;

B4.4 demonstrate the ability to assess the health and well-being of children and older adults on the basis of case studies or simulations *(e.g., by considering body temperature, skin condition, evidence of bruising, difficulties in ambulation, affect)*;

B4.5 demonstrate the correct use of the following: a defibrillator for cardiac arrhythmia; techniques of cardiopulmonary resuscitation (CPR); basic first aid *(e.g., to treat burns, cuts, choking, fever)*;

B4.6 demonstrate the correct use of safety devices *(e.g., grab bars, wheelchair, Zimmer frame, high chair, safety gate, car seat)* when caring for children and older adults;

B4.7 demonstrate practices and the use of aids that protect the safety of children and older adults *(e.g., place safety locks on cabinets, cover electrical outlets, remove sharp objects, cover sharp corners and edges, tuck in blind cords, use Velcro closures on shoes, provide non-skid mats, ensure proper lighting, provide appropiately designed cooking utensils for arthritic clients)*.

B5. Communication Skills

By the end of this course, students will:

B5.1 demonstrate the ability to communicate effectively with children and older adults, taking their stage of development and/or condition into account *(e.g., use age-appropriate language, compensate for hearing or visual deficits)*;

B5.2 recognize and compensate for possible language barriers by using action signs or providing an interpreter, and be aware of cultural differences in communication styles, interpersonal behaviour, and attitudes and customs *(e.g., attitudes towards Western medical treatments and procedures, customs regarding the treatment of children and older adults)*.

C. HEALTH CARE, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. analyse how environmental factors affect children and older adults, and how products and services related to the care of these groups may affect the environment;

C2. analyse the role of society in caring for children and the elderly.

SPECIFIC EXPECTATIONS

C1. Health Care and the Environment

By the end of this course, students will:

C1.1 analyse the environmental impact of products developed to meet the needs of children and the elderly *(e.g., landfill issues – throw-away toys, batteries, disposable diapers, plastic baby bottles)* and identify more sustainable alternatives with respect to the use of such products;

C1.2 analyse the impact of a degraded environment and other environmental hazards on children and the elderly *(e.g., increased rates of respiratory problems, detrimental effects of lead paint, effects of environmental estrogens)*.

C2. Health Care and Society

By the end of this course, students will:

C2.1 describe how accessibility issues affect the lives of children and older adults *(e.g., wheelchair access, adapted transportation)*;

C2.2 evaluate the impact of emerging technologies on children and older adults *(e.g., improved design of diapers or incontinence products, new skin care products, video monitoring from a remote site, electronic lifts)* from various perspectives *(e.g., safety, improvement or reduction in quality of life, financial or business implications, opportunities for more effective action for improved health care)*;

C2.3 describe how changing population patterns will affect society *(e.g., decrease in child cohort resulting in excess capacity in schools, increase in elderly cohort resulting in increased demand for different levels of care)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and comply with laws, regulations, and guidelines related to the health, safety, and care of children and older adults;

D2. describe careers in child care, geriatric care, and related fields, as well as the education and/or training requirements for them.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify and describe laws, regulations, and guidelines related to the health and safety of children and older adults *(e.g., car seat regulations, Daycare and Nursery Act, senior driver's licence requirements, accessible parking permit, Long Term Care Act, Patient Bill of Rights)*;

D1.2 identify health and safety standards in workplaces involving child care and geriatric care *(e.g., appropriate safety protocols, including clear walkways, proper lighting, immunization requirements)*;

D1.3 identify laws, regulations, and guidelines that relate to various aspects of the lives of children and older adults *(e.g., custody arrangements, living wills/power of attorney, Personal Health Information Act [PHIA], confidentiality and privacy laws)*;

D1.4 identify, on the basis of research, hazards that can affect the safety of children and older adults *(e.g., absence of fire extinguishers and/or fire alarms, lack of information about food or medication allergies, improper household chemical storage, extreme water temperatures)*;

D1.5 explain the importance of proper labelling of hazardous materials *(e.g., to protect against ingestion of hazardous products)*.

D2. Career Opportunities

By the end of this course, students will:

D2.1 research and describe careers in child care *(e.g., Early Childhood Educator)* and gerontology *(e.g., Recreational/Activation Therapist)*, and outline related education and training requirements;

D2.2 research and identify occupations that are concerned with products and services for helping children and older adults *(e.g., video or Internet access to day-care centres, phone access for the hearing impaired, motorized wheelchairs/scooters)*;

D2.3 describe how technological advances have affected employment opportunities in child care and gerontology *(e.g., advances in medical technology such as continuous positive airway pressure [CPAP] respirators, which allow patients to stay at home rather than be hospitalized, have resulted in an increase in home-care jobs)*;

D2.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the health care industry, as identified in the Ontario Skills Passport *(e.g., computer use, data analysis, job task planning and organizing)*;

D2.5 demonstrate an understanding of and apply the work habits that are important for success in the health care industry, as identified in the Ontario Skills Passport *(e.g., teamwork, organization, self-advocacy)*;

D2.6 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in child and geriatric care *(e.g., Passport to Safety certificate, reports, assignments, Ontario Skills Passport Work Plan and Transition Plan)*, and explain why having a current portfolio is important for career development and advancement.

Health Care: Support Services, Grade 12

Workplace Preparation

TPJ4E

This course enables students to develop the basic skills needed for careers in a range of health care support services. Students will practise and apply a variety of clinical procedures and infection control skills as they learn about principles of infection control, service excellence, and the nature of the health care industry. Students will also investigate workers' health and safety issues, environmental and societal issues related to health care, and career opportunities in the field.

Prerequisite: None

A. HEALTH CARE FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of health care terminology and its correct usage;

A2. demonstrate an understanding of the basic anatomy and physiology of the human body;

A3. identify relationships between lifestyle and the health of individuals;

A4. demonstrate an understanding of the chain of infection and practices for preventing the transmission of infection;

A5. compare conventional and complementary methods of disease prevention and treatment.

SPECIFIC EXPECTATIONS

A1. Health Care Terminology

By the end of this course, students will:

A1.1 demonstrate an understanding of terminology related to health care concepts and procedures *(e.g., nothing by mouth/nil per os [NPO], rehabilitation, gerontology, acute, chronic)*, and use it correctly in oral and written communication;

A1.2 demonstrate an understanding of health care terminology describing parts of the human body and their location *(e.g., abdominal cavity, cranial cavity, posterior, superior)*, and use it correctly in oral and written communication.

A2. Anatomy and Physiology

By the end of this course, students will:

A2.1 identify the relationships between cells, tissues, organs, and systems in the structure of the human body *(e.g., different types of cells and cell arrangements in tissues, different types of tissues for different purposes in organs, combinations of organs working together in body systems)*;

A2.2 demonstrate a basic understanding of the anatomy and physiology of the human musculoskeletal system *(e.g., demonstrate types of movement for a variety of joints, such as flexion and extension of a hinge joint; identify major bones and muscles of the body)*;

A2.3 demonstrate a basic understanding of the anatomy and physiology of the human cardiovascular system *(e.g., by building a model of the heart to identify major structural features and blood flow)*;

A2.4 demonstrate a basic understanding of the anatomy and physiology of the human respiratory system *(e.g., by building a functional respiratory model to illustrate the mechanism of breathing)*;

A2.5 demonstrate a basic understanding of the anatomy and physiology of the human digestive system *(e.g., by developing a model illustrating the digestive pathway)*.

A3. Lifestyle and Personal Health

By the end of this course, students will:

A3.1 identify the impact of alterations in health *(e.g., hospitalization, long-term illness or disability)* throughout the lifespan *(e.g., impact on a toddler, teenager, elderly person)*;

A3.2 describe how lifestyle choices *(e.g., amount of sleep, dietary and exercise habits, substance use and abuse)* can affect an individual's health and well-being.

A4. Infection Control

By the end of this course, students will:

A4.1 identify components of the chain of infection *(e.g., host, reservoir, mode of transmission, portal of entry)*;

A4.2 describe routine practices for preventing the transmission of infection *(e.g., isolation cleaning; droplet precautions; contact precautions; donning personal protective equipment such as gloves, masks, and gowns; disposal of body fluids)* and the indications for implementing them.

A5. Disease Prevention and Treatment

By the end of this course, students will:

A5.1 compare conventional and complementary approaches to health care in terms of the therapeutic approaches used *(e.g., pharmaceutical medications versus herbal/natural remedies)* and the types of practitioners offering the services *(e.g., physicians versus homeopaths or Aboriginal healers)*;

A5.2 compare conventional and complementary treatment methods for a variety of health care issues *(e.g., nicotine patch versus acupuncture for cessation of smoking)*.

B. HEALTH CARE SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. identify instruments, equipment, and materials that are commonly used in the health care industry, and use them correctly and safely;

B2. use vital signs to assess a person's health status;

B3. demonstrate the ability to apply health care skills and techniques safely and to industry standards;

B4. demonstrate the ability to apply a variety of techniques for communicating with clients and collecting client information.

SPECIFIC EXPECTATIONS

B1. Instruments, Equipment, and Materials

By the end of this course, students will:

B1.1 identify and explain the purpose of common instruments, equipment, and materials used for client care in the health care industry *(e.g., patient lift, commode, intravenous [IV] pole, hospital bed, wheelchair)*, and apply correct procedures for their use;

B1.2 identify health care problems related to the use of instruments, equipment, or materials *(e.g., spread of infection through a health care facility as a result of the use of contaminated equipment)*, and apply proper control procedures *(e.g., hand hygiene protocols, use of personal protective equipment guidelines, proper handling of bed linens)* to prevent their occurrence.

B2. Vital Signs

By the end of this course, students will:

B2.1 demonstrate the ability to use instruments *(e.g., thermometer, sphygmomanometer, stethoscope)* to measure the four primary vital signs (temperature, pulse, respiration, and blood pressure);

B2.2 assess and document a client's vital signs: temperature (by oral, axillary, and tympanic routes), pulse rate (by apical and radial sites), respiration rate, and blood pressure;

B2.3 identify normal values for temperature, pulse, respiration, and blood pressure across the lifespan, and identify possible health implications of abnormal values *(e.g., elevated temperature suggests a possible infection)*.

B3. Skills and Techniques

By the end of this course, students will:

B3.1 demonstrate an understanding of correct hand hygiene procedures *(e.g., knowing when they are required, knowing when to use hand washing rather than antibacterial sanitizers)*, and apply as required;

B3.2 make an unoccupied and occupied bed correctly, using correct principles of infection control;

B3.3 perform mobility techniques *(e.g., turning, lifting, and transferring clients; using crutches or walkers and instructing clients in their use)* correctly and safely;

B3.4 demonstrate an understanding of and apply proper body mechanics and ergonomics when performing health care procedures *(e.g., bend with the knees instead of the back, use a wide base of support when lifting or turning)*;

B3.5 demonstrate an understanding of and apply safe practices for handling, preparing, and storing food in a real or simulated care environment *(e.g., use proper cooking temperatures to kill bacteria; check that clients' food tolerances, requirements, or restrictions are observed)*;

B3.6 demonstrate an understanding of and apply infection control skills in a simulated care environment *(e.g., isolation cleaning; droplet precautions; contact precautions; donning personal protective equipment such as gloves, masks, and gowns; disposal of body fluids).*

B4. Communication and Documentation

By the end of this course, students will:

B4.1 demonstrate an understanding *(e.g., through role play)* of therapeutic communication techniques, including conflict-resolution skills;

B4.2 identify various communication barriers *(e.g., barriers relating to health condition, age and stage of development, and differing cultural communication styles),* and apply strategies to overcome these difficulties.

C. HEALTH CARE, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. identify the impact of medical wastes on the environment, and describe ways of protecting the environment from these hazards;

C2. demonstrate an understanding of ways in which health care issues and societal issues are interrelated.

SPECIFIC EXPECTATIONS

C1. Health Care and the Environment

By the end of this course, students will:

C1.1 identify the environmental impact of technological advances in the health care field *(e.g., single-use devices create end disposal issues, as incineration results in heavy metal toxicity and landfilling creates biohazardous leachate; because of the increased use of pharmaceuticals, traces of prescription drugs are now being found in surface water)*;

C1.2 research and report on laws, regulations, guidelines, and information sources pertaining to the disposal of medical waste *(e.g., Atomic Energy Control Board – radioactive materials; Workplace Hazardous Materials Information System [WHMIS] – chemical hazards; Ontario Regulation 102/94 – waste management)*.

C2. Health Care and Society

By the end of this course, students will:

C2.1 identify current societal trends or issues and their implications for health care *(e.g., lack of exercise leading to increased obesity and related health problems; aging of the population and increased need for geriatric care; global travel and increased prevalence of exotic diseases; cultural diversity and the increased complexity of delivering health care)*;

C2.2 identify current health care issues from recent media coverage and describe their societal implications *(e.g., outbreaks of potentially epidemic diseases and the need for social controls such as quarantine; challenges in providing basic health care resources in remote communities; funding limitations and costs of covering expensive treatments and drugs; antibiotic-resistant diseases, nosocomial infection)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

> **D1.** demonstrate an understanding of laws and regulations governing the health and safety of workers in the health care industry;
>
> **D2.** demonstrate an understanding of legal and ethical standards governing the practice of health care in Ontario;
>
> **D3.** demonstrate an understanding of the principles of good customer service and client-centred care, and apply these principles in a simulated care setting;
>
> **D4.** describe career opportunities in the health care field and their related educational requirements.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify and describe legislation and sources of information pertinent to worker safety in the health care workplace *(e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS]);*

D1.2 demonstrate an understanding of and apply safe procedures for the use of tools, materials, and equipment as outlined in safety manuals, operating instructions, and institutional requirements;

D1.3 describe and apply safe methods for the handling, storage, and disposal of waste and biohazardous materials *(e.g., use of a sharps container);*

D1.4 use protective clothing and equipment as required to keep themselves and others safe and free from harm.

D2. Professional Standards

By the end of this course, students will:

D2.1 identify the principal components of legislation regulating the practice of health care in Ontario *(e.g., Regulated Health Professions Act [RHPA] sets the framework for regulating the scope of practice of health professions);*

D2.2 describe the professional and ethical standards that health care workers are expected to adhere to *(e.g., accountability, knowledge, competence, respect for patients' rights and privacy, confidentiality, respect for cultural and religious diversity, respect for the sanctity of life);*

D2.3 explain the importance of informed consent and informed decision making in client care;

D2.4 describe what health care workers can do to project a professional image *(e.g., behave courteously at all times; respond to client inquiries promptly and accurately; be supportive; wear appropriate clothing and maintain a tidy personal appearance; wear a name badge and keep it visible at all times)*, and explain why it is important to do so.

D3. Client-centred Care

By the end of this course, students will:

D3.1 demonstrate an understanding of how to manage time and provide care efficiently in order to enhance client outcomes;

D3.2 explain the importance of understanding client expectations and helping clients understand what they can reasonably expect of high-quality client service, and describe some of the benefits of working to exceed those expectations;

D3.3 demonstrate an understanding of and apply effective service recovery techniques *(e.g., actively listen to complaints, offer blameless apologies, propose solutions)* to resolve client complaints and grievances.

D4. Career Opportunities

By the end of this course, students will:

D4.1 identify career opportunities in the health care field and describe the education and/or training required for entry into these occupations;

D4.2 describe the various types of community health and social services *(e.g., community care access centres, nursing, mental health services, physiotherapy, laboratory services, Meals on Wheels, vision care services)* available in their community and the career opportunities they provide;

D4.3 demonstrate an understanding of and apply the Essential Skills that are important for success in the health care industry, as identified in the Ontario Skills Passport *(e.g., computer use, data analysis, job task planning and organizing);*

D4.4 demonstrate an understanding of and apply the work habits that are important for success in the health care industry, as identified in the Ontario Skills Passport *(e.g., teamwork, organization, self-advocacy);*

D4.5 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in health care *(e.g., Passport to Safety certificate, reports, assignments, Ontario Skills Passport Work Plan and Transition Plan)*, and explain why having a current portfolio is important for career development and advancement.

HOSPITALITY AND TOURISM

Hospitality and tourism is one of the top fields for employment in Canada. Hospitality and tourism courses prepare students to meet diverse challenges in this multifaceted field.

Hospitality and tourism education provides both a hands-on and a theoretical approach to learning about the various sectors in the field. Students will have opportunities to develop essential food preparation and presentation skills; will learn about event planning and marketing, customer relations, human resource management, inventory management, and tourism administration and management; and will examine the cultural and economic forces that drive tourism trends. Students will gain experience with equipment and procedures commonly used in their particular sectors of interest, and will comply with health and safety regulations and standards that govern the various sectors in the tourism industry. They will acquire a foundation of skills and knowledge that will prepare them for both postsecondary education and careers in hospitality and tourism.

The list of approved emphasis areas for hospitality and tourism can be found at www.edu.gov.on.ca/eng/curriculum/secondary/teched.html.

- Courses in technological education are suitable for use in cooperative education programs and in connection with other forms of experiential learning as well as in programs such as the Specialist High Skills Major (SHSM). For more information, see pages 43–44 of this document.
- For policy guidelines pertaining to multiple-credit courses and emphasis courses, see pages 17–18 of this document.

Hospitality and Tourism, Grade 11

College Preparation

TFJ3C

This course enables students to develop or expand knowledge and skills related to hospitality and tourism, as reflected in the various sectors of the tourism industry. Students will learn about preparing and presenting food, evaluating facilities, controlling inventory, and marketing and managing events and activities, and will investigate customer service principles and the cultural and economic forces that drive tourism trends. Students will develop an awareness of health and safety standards, environmental and societal issues, and career opportunities in the tourism industry.

Prerequisite: None

A. HOSPITALITY AND TOURISM FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of hospitality and tourism as represented by the various sectors of the tourism industry;

A2. demonstrate an understanding of health and wellness issues and concerns as they relate to the tourism industry;

A3. demonstrate an understanding of fundamental culinary knowledge;

A4. demonstrate an understanding of tools, equipment, and facilities used in the various sectors of the tourism industry.

SPECIFIC EXPECTATIONS

A1. The Tourism Industry

By the end of this course, students will:

A1.1 describe the role and characteristics of each of the sectors of the tourism industry (*e.g., accommodations, food and beverage services, recreation and entertainment, transportation, travel services*);

A1.2 explain how various types of services, events, and activities from around the province (*e.g., youth hostels, air transportation, ecotourism, weddings, guided tours*) are associated with one or more sectors of the tourism industry;

A1.3 identify and describe a variety of factors that have contributed to the growth of the tourism industry (*e.g., economic growth, rising disposable incomes, package vacations, cut-price air fares, improved transportation equipment and facilities that reduce travel time and stress*);

A1.4 explain how the location of facilities and the range and quality of available resources can affect customer service and satisfaction (*e.g., tourists prefer accommodation that is close to the main attractions; equipment limitations reduce the scope of tourist activities*);

A1.5 explain the importance of understanding the life cycle of tourist destinations (i.e., inception, growth, maturity, decline);

A1.6 explain the effect of the weather and seasonal changes on the availability, pricing, and quality of products and services within the tourism industry;

A1.7 describe, on the basis of research, the various strategies used by tourism companies to increase their market share (*e.g., loyalty reward plans, prizes and contests, customer appreciation days*);

A1.8 describe the role of the government and of industry associations in regulating and supporting the tourism industry;

A1.9 explain how societal trends are changing the tourism industry (*e.g., the aging of the population in Canada is increasing the demand for travel and recreational activities for the elderly; interest in viniculture is rising, causing an increase in visits to wineries; health awareness is increasing, causing more people to visit health resorts and spas*);

A1.10 assess the usefulness of information systems in contributing to value-added processes in the tourism industry (*e.g., use of databases to enhance customer service by tracking customer usage for a reward/points system and/or maintaining client profiles [with pictures] to facilitate recognition of clients and their preferences/needs*).

A2. Health and Wellness

By the end of this course, students will:

A2.1 identify new types of food products that have been developed through research, and describe health and safety issues related to their consumption (*e.g., "power" drinks and their consumption by youth, hormone-rich beef and its consumption by children and pregnant women, gluten-free products for people with gluten allergies*);

A2.2 identify the essential principles of nutrition as referenced in Canada's Food Guide and accompanying resources *(e.g., Eating Well with Canada's Food Guide [2007]; Eating Well with Canada's Food Guide: First Nations, Inuit and Métis; cultural adaptations of Canada's Food Guide available from the Ontario Public Health Association)*;

A2.3 identify ways in which lifestyle, health, and age affect a person's dietary and nutritional needs *(e.g., **lifestyle:** people who are not physically active need fewer calories than those who exercise regularly; **health:** diabetics require a diet that is low in sugar and carbohydrates to keep their blood-sugar level in balance; **age:** women as they age require calcium supplements to combat osteoporosis)*;

A2.4 explain the connection between the dietary environment *(e.g., the types of foods that are widely available and the quantities in which they are sold)* and the food choices people make *(e.g., fast-food nation – the ubiquity of fast-food outlets leads to a high consumption of processed foods; super-size option – products offered in super-size servings encourage over-eating)*;

A2.5 identify the causes of food-borne illnesses *(e.g., salmonella, Norwalk virus,* E. coli*)*, the associated medical symptoms *(e.g., nausea, stomach cramps, fever)*, and methods of prevention *(e.g., storing, handling, and cooking food appropriately)*.

A3. Culinary Knowledge

By the end of this course, students will:

A3.1 demonstrate an understanding of common measurements used in the food and beverage services sector, in metric, US customary, and British imperial units *(e.g., weight – grams, ounces, pounds; volume – millilitres, fluid ounces)* and in degrees Celsius and Fahrenheit;

A3.2 describe common ingredients used in food preparation *(e.g., types of flour, types of sugars/sweeteners, types of fats)*;

A3.3 identify and describe a variety of ingredients that add flavour to food products *(e.g., herbs, spices, essences, vinegars)*;

A3.4 identify and describe a variety of basic cooking methods *(e.g., **dry:** roasting, frying; **moist:** boiling; **combination:** braising)*;

A3.5 identify key characteristics that define a particular cuisine *(e.g., French, Italian, Thai, Aboriginal, fusion, nouvelle, vegetarian)*;

A3.6 evaluate the effects of food preservation techniques *(e.g., **freezing:** vegetables lose their taste; **dehydrating:** food loses its moisture and texture; **canning:** food tastes sweeter because sugar is added; **pickling:** food tastes saltier because sodium is added; **smoking:** food acquires a smoky flavour and contains added chemicals as a result of the smoking process)*;

A3.7 describe the effects of climate and season on the availability, quality, price, and nutritional value of food products and services.

A4. Tools, Equipment, and Facilities

By the end of this course, students will:

A4.1 identify various small wares used in the kitchen *(e.g., hand tools, table-top mixers, pots)*;

A4.2 identify tools and equipment commonly used in the various sectors of the tourism industry *(e.g., stoves and mixers in the food and beverage services sector, phones and computers in the travel services sector, computer reservation systems in the accommodations sector)*;

A4.3 demonstrate the ability to operate and maintain a variety of tools and equipment commonly used in different sectors of the tourism industry *(e.g., stoves, computers, vacuum cleaners, audio-visual equipment)*, using proper processes and procedures;

A4.4 identify the sorts of facilities that are associated with various types of successful tourism services and operations *(e.g., catering, conference and convention, resorts, adventure lodges, airports, cruise ships, travel agencies)*;

A4.5 explain how colour, layout, and lighting can be used to enhance various settings related to tourism *(e.g., decor and lighting in hotel rooms, arrangement of tables and use of candles in dining areas, floral arrangements in reception areas, layout and design of a buffet)*.

B. HOSPITALITY AND TOURISM SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. prepare and present food products in a variety of ways, following accepted industry procedures;

B2. demonstrate the ability to follow the best practices of administration and management as they relate to the tourism industry;

B3. design effective marketing initiatives to promote an event or activity;

B4. apply appropriate management principles and practices to plan and execute an event or activity.

SPECIFIC EXPECTATIONS

B1. Food Preparation and Presentation

By the end of this course, students will:

B1.1 demonstrate the use of various cooking techniques *(e.g., sauté, deep fry, roast, poach, steam, braise)* to produce a variety of foods *(e.g., meats, vegetables, rice and pasta dishes, desserts, bakery products)*;

B1.2 prepare food using appropriate culinary techniques *(e.g., shucking, kneading, clarifying, deglazing)* to enhance edibility, colour, texture, taste, and contrast;

B1.3 use a variety of flavours to enhance the taste of foods *(e.g., herbs, spices, vinegars, oils)*, and functional garnishes to enhance their presentation;

B1.4 present food products in different types of service *(e.g., plate, platter, buffet, cafeteria, take-out)* to suit the occasion;

B1.5 prepare foods that accommodate a variety of specific customer needs *(e.g., dietary, religious, cultural, allergy related)*;

B1.6 prepare a creative, attractive place-setting appropriate to the occasion or context *(e.g., with a bouquet of flowers and with napkins folded in a unique way)*;

B1.7 set a table in an appropriate and professional manner *(e.g., paying attention to the choice of utensils and glassware, the design of the centre-piece, the colour and presentation of napkins)* for a variety of circumstances.

B2. Administration and Management Practices

By the end of this course, students will:

B2.1 demonstrate an understanding of the information and communications technology used in the various sectors of the tourism industry *(e.g., point-of-sale [POS] systems, e-tickets, online reservation systems)*;

B2.2 demonstrate the ability to make individual contributions to overall team performance *(e.g., in a brigade system; as a "front of the house" [serving staff] member, "back of the house" [kitchen staff] member; in sales and/or marketing)*;

B2.3 use appropriate mathematical skills to accurately calculate food cost percentage based on the actual cost of food and the selling price per serving;

B2.4 demonstrate correct procedures for storing, rotating, and maintaining inventory *(e.g., use of the "first in, first out" [FIFO] method; implementation and maintenance of Hazard Analysis and Critical Control Point [HACCP] systems)*.

B3. Marketing and Promoting an Event or Activity

By the end of this course, students will:

B3.1 identify a customer target group *(e.g., students, family members, senior citizens)* for an event or activity and determine the needs and wants of this target group *(e.g., with regard to timing, budget, menu, facilities, location)*;

B3.2 develop a marketing strategy that is appropriate to the target group and the event or activity;

B3.3 design an advertising and/or promotional tool *(e.g., picture, slogan, announcement, give-away)* that aligns with their approved marketing strategy.

B4. Managing an Event or Activity

By the end of this course, students will:

B4.1 create an action plan for staging an event or activity *(e.g., multicultural festival, graduation ceremony, meal for homeless persons)* in their school or community;

B4.2 identify and locate the resources needed to undertake an event or activity *(e.g., dining-room furniture, cooking equipment, lodging, transportation equipment)*;

B4.3 demonstrate appropriate planning, organizational, and time management skills when managing an event or activity *(e.g., prepare the mise en place; prepare a work schedule, production schedule, room attendant record sheets; prepare a trip itinerary)*;

B4.4 create appropriate purchase requisitions for different purposes *(e.g., to order food, cleaning products, or promotional materials)*;

B4.5 demonstrate the ability to apply appropriate inventory control procedures *(e.g., related to purchasing, receiving, storage, waste control)*;

B4.6 use appropriate mathematical skills to accurately calculate the actual cost and revenues of an event or activity *(e.g., fundraiser, package tour)*.

C. INDUSTRY PRACTICES, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of factors that affect the relationship between the tourism industry and the environment;

C2. demonstrate an understanding of factors that affect the relationship between the tourism industry and society.

SPECIFIC EXPECTATIONS

C1. Industry Practices and the Environment

By the end of this course, students will:

C1.1 explain the need for environmentally friendly waste management in the various sectors of the tourism industry *(e.g., with regard to disposal of cooking oil and garbage, recycling of plastic and glass, composting of organic waste)*;

C1.2 define environmental sustainability as it applies to the various sectors of the tourism industry *(e.g., staying within the carrying capacity of environmentally sensitive areas; using energy-efficient buildings, equipment, and transportation; reusing and/or recycling waste products)*;

C1.3 explain how the relationship between food producers and food consumers affects the environment *(e.g., production of organic foods in response to consumer demand results in less use of chemical fertilizers and pesticides; the Slow Food movement supports local food production and the continuing use of traditional food products; culinary tourism increases consumer awareness of and helps to support traditional food producers in many parts of the world)*;

C1.4 assess the ecological footprint of an event or activity.

C2. Industry Practices and Society

By the end of this course, students will:

C2.1 describe how various sectors of the tourism industry *(e.g., accommodations, food and beverage services)* address needs and preferences arising from the cultural and religious diversity of their customers, and assess the effect this has on communities hosting tourist destinations;

C2.2 describe ways in which the tourism industry can affect the economy of a community *(e.g., multiplier effect – opening a new business creates secondary jobs, which in turn encourages further business activity; necessary leakage – much of the money spent by tourists [such as air fares] remains in the originating market or goes to tourism-related businesses outside the community)*;

C2.3 describe the social responsibility of companies and workers in the tourism industry *(e.g., with regard to equal employment opportunities, conservation and preservation of the environment, relations with local communities)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and compliance with health and safety standards in the various sectors of the tourism industry;

D2. demonstrate an understanding of the importance of customer service;

D3. identify career opportunities in the tourism industry and the individual personality traits and skills important for success in these careers.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify the laws, regulations, and regulatory/oversight organizations that govern health, safety, and sanitary standards in the tourism industry *(e.g., Occupational Health and Safety Act [OHSA], Health Protection and Promotion Act [HPPA], Workplace Hazardous Materials Information System [WHMIS] regulations, local health departments)* and explain their importance;

D1.2 demonstrate an understanding of emergency preparedness *(e.g., develop an emergency exit plan, ensure all safety equipment is clearly identified and easily accessible and that equipment lock-out rules are posted)* and procedures to be followed *(e.g., regarding equipment power shut-off, the use of fire-suppression equipment)* in the event of an accident or emergency situation;

D1.3 demonstrate the ability to follow health and safety best practices *(e.g., report unsafe work conditions in the school classroom/facility; use the Workplace Hazardous Materials Information System [WHMIS]; know appropriate first aid procedures to be used in the event of an accident such as a burn, cut, or electric shock)*;

D1.4 demonstrate the use of safe food handling and proper sanitary practices *(e.g., prevent cross-contamination of foods; keep their person and uniform clean; wear hair nets; observe good housekeeping practices, safe lifting practices)*;

D1.5 use protective clothing and equipment as required to ensure their own and others' safety in the work environment;

D1.6 identify and describe health and safety issues that must be considered in the workplace *(e.g., issues concerning trip and fall, exposure to chemicals, the effects of fatigue, and long-term ergonomic considerations)*.

D2. Customer Service

By the end of this course, students will:

D2.1 describe the relationship between the customer and the service provider;

D2.2 identify and describe fundamental principles of customer service *(e.g., reliability, accountability, caring, responsiveness)*;

D2.3 explain how interpersonal, intrapersonal, and problem-solving skills are used to demonstrate professionalism and provide high-quality customer service;

D2.4 analyse how the quality of customer service affects the viability of various tourism businesses *(e.g., hotels, resorts, restaurants, private clubs, health spas)*.

D3. Career Opportunities

By the end of this course, students will:

D3.1 identify the sectors of the tourism industry that are prominent in their local community and/or region and those that are prominent in the province as a whole;

D3.2 describe the physical and psychological challenges experienced by persons working in the tourism industry *(e.g., multi-tasking, dealing with*

stressful situations, maintaining personal fitness, adapting to an unconventional lifestyle);

D3.3 identify the range of careers available in the tourism industry *(e.g., travel agent, restaurant owner/manager, event planner);*

D3.4 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the tourism industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations);*

D3.5 demonstrate an understanding of and apply the Essential Skills that are important for success in the tourism industry, as identified in the Ontario Skills Passport *(e.g., document use, scheduling or budgeting and accounting, job task planning and organizing);*

D3.6 demonstrate an understanding of and apply the work habits that are important for success in the tourism industry, as identified in the Ontario Skills Passport *(e.g., teamwork, reliability, customer service);*

D3.7 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements related to hospitality and tourism *(e.g., Passport to Safety certificate, Ontario Skills Passport Work Plan, photographs of participation in an event or activity, recipe catalogue),* and explain why having a current portfolio is important for career development and advancement.

Hospitality and Tourism, Grade 11

Workplace Preparation

TFJ3E

This course enables students to acquire knowledge and skills related to the food and beverage services sector of the tourism industry. Students will learn how to prepare, present, and serve food using a variety of tools and equipment, and will develop an understanding of the fundamentals of providing high-quality service to ensure customer satisfaction and the components of running a successful event or activity. Students will develop an awareness of health and safety practices, environmental and societal issues, and career opportunities in the food and beverage services sector.

Prerequisite: None

A. HOSPITALITY AND TOURISM FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. describe the types of operations included in the food and beverage services sector of the tourism industry and the range of services these operations provide;

A2. assess the characteristics of a variety of food products to determine their nutritional content and local availability and the appropriate methods of cooking each food product;

A3. demonstrate an understanding of tools, equipment, and facilities commonly found in the food and beverage services sector of the tourism industry.

SPECIFIC EXPECTATIONS

A1. The Food and Beverage Services Sector

By the end of this course, students will:

A1.1 identify and describe the various sectors of the tourism industry (*e.g., accommodations, recreation and entertainment, food and beverage services, transportation, travel services*);

A1.2 describe how the food and beverage services sector and other sectors of the tourism industry are interdependent (*e.g., restaurants and coffee shops in hotels and airports benefit from the strong customer base provided by those facilities, and also enhance the appeal of the facilities for travellers*);

A1.3 identify and describe the various businesses within their community that are associated with the food and beverage services sector (*e.g., restaurants, coffee shops, club facilities, fast-food outlets, catering services*);

A1.4 describe typical staff positions in the food and beverage services sector (*e.g., front of the house – hostess, server, bartender; back of the house – chef, cook, dishwasher*);

A1.5 identify and describe the most common types of dining-room service (*e.g., buffet, à la carte, formal, cafeteria*).

A2. Characteristics of Foods

By the end of this course, students will:

A2.1 assess the basic nutritional values (*e.g., in terms of carbohydrates, proteins, fats, vitamins, minerals*) of a variety of food products, using appropriate resources (*e.g., Eating Well with Canada's Food Guide [2007]; Eating Well with Canada's Food Guide: First Nations, Inuit and Métis*);

A2.2 identify and describe commonly used ingredients in cooking and baking (*e.g., leavening agents, types of flour, types of fats, salt, sugar*);

A2.3 identify a variety of ingredients used to add flavour and complexity to foods (*e.g., herbs [basil, oregano, rosemary, thyme], spices [black pepper, paprika], salt, sugar, garlic, ginger*);

A2.4 describe and demonstrate a variety of cooking methods used to prepare foods (*e.g., **moist heat**: poaching, boiling; **dry heat**: roasting, baking; **combination**: stewing*);

A2.5 identify various food products that come from a particular region or regions of the world and describe them in terms of their variety and availability.

A3. Tools, Equipment, and Facilities

By the end of this course, students will:

A3.1 identify and describe appropriate procedures for the safe set-up, use, and maintenance of equipment used in a variety of activities in the food and beverage services sector;

A3.2 describe proper procedures for using a variety of tools commonly used in the food and beverage services sector;

A3.3 identify and describe a variety of facilities found in the food and beverage services sector;

A3.4 describe the measurement systems based on metric, US customary, and British imperial units, and explain how these systems affect the use of tools and equipment commonly used in the food and beverage services sector.

B. HOSPITALITY AND TOURISM SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. demonstrate technical proficiency in the use and maintenance of tools and equipment related to the food and beverage services sector of the tourism industry;

B2. use appropriate techniques for handling, preparing, and presenting food products;

B3. demonstrate an understanding of appropriate procedures to follow in planning an event or activity.

SPECIFIC EXPECTATIONS

B1. Using Tools and Equipment

By the end of this course, students will:

B1.1 demonstrate proficiency in using a variety of tools and equipment related to the food and beverage services sector (*e.g., stoves, cash registers, floor mixer, telephone*);

B1.2 use standard measuring tools to accurately determine, in metric, US customary, or British imperial units as appropriate, the weight and/or volume of ingredients for meal preparation and, in degrees Celsius or Fahrenheit, the cooking temperature required;

B1.3 maintain tools and equipment related to the food and beverage services sector (*e.g., sharpen a knife, clean a food processor, clean a ventilation system*) safely and correctly.

B2. Food Handling, Preparation, and Presentation

By the end of this course, students will:

B2.1 apply Health Protection and Promotion Act (HPPA) standards in handling, storing, and preparing food products (*e.g., cook and/or store food at the proper temperature; apply the "first in, first out" [FIFO] method in selecting ingredients*);

B2.2 prepare simple recipes (*e.g., breads, cookies, vegetable dishes, stocks, soups, poultry*) using readily available ingredients;

B2.3 prepare and present creative, attractive, and functional plate garnishes (*e.g., sprig of rosemary, tomato rose, strawberry arrangement*) appropriate for the food being served;

B2.4 convert recipes correctly in order to increase or decrease their yield (i.e., the number of persons who can be served);

B2.5 set a table in an appropriate manner to suit the circumstances (*e.g., paying attention to the choice and arrangement of utensils and glassware, the design of the centrepiece, the way napkins are folded, and the number of place settings required*);

B2.6 apply a variety of food and beverage services skills (*e.g., order taking, order of service, table busing*) as required, in accordance with industry standards.

B3. Planning an Event or Activity

By the end of this course, students will:

B3.1 research and report on a local and/or provincial tourism event or activity (*e.g., music festival, sporting event, product show, cultural event*) and identify the components that made the event or activity successful;

B3.2 design an event or activity and complete the appropriate preparations for the event or activity (*e.g., mise en place, trip itinerary, production schedule*);

B3.3 identify the equipment required for an event or activity (*e.g., chafing dishes for buffet service, insulated carrier for offsite catering, tables and tent for outside reception*) and identify the cost of purchasing or renting the equipment;

B3.4 apply principles of advertising in promoting a school event or community activity (*e.g., create a marketing campaign for a local tourism event*);

B3.5 use computer software to prepare and present a variety of documents related to an event or activity (*e.g., menu, brochure, advertisement*).

C. INDUSTRY PRACTICES, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of ways in which various practices of the food and beverage services sector of the tourism industry affect the environment;

C2. demonstrate an understanding of ways in which various aspects of the food and beverage services sector of the tourism industry affect society.

SPECIFIC EXPECTATIONS

C1. Industry Practices and the Environment

By the end of this course, students will:

C1.1 describe environmentally friendly disposal procedures for waste food products and food packaging *(e.g., composting, recycling)*;

C1.2 create a plan to implement an environmentally friendly disposal procedure for waste food products and/or food packaging *(e.g., a plan to set up a composting or recycling program in the school cafeteria, a plan to encourage the use of biodegradable containers for take-out food)*;

C1.3 explain how the food and beverage services sector can support the achievement of environmentally responsible goals *(e.g., goals of ecotourism, conservation goals, preservation goals)*;

C1.4 assess the ecological footprint of an event or activity.

C2. Industry Practices and Society

By the end of this course, students will:

C2.1 describe the social and economic impact of new products and technologies used in the food and beverage services sector *(e.g., marketing of organic and genetically modified foods has raised consumer awareness of health and environmental issues; use of combination ovens has reduced labour costs and product wastage; advances in wireless technology have increased the popularity of Internet cafés)*;

C2.2 explain how the food and beverage services sector can affect the economy of a community *(e.g., businesses in the sector create jobs and attract visitors; tourist spending supports the community)* and how these effects can vary with changes in economic conditions *(e.g., exchange rate fluctuations can encourage or discourage tourist travel and thus affect the number of visitors to the community; an economic downturn can result in reduced spending on hospitality and tourism-related activities, which can lead to a loss of jobs in the community)*;

C2.3 describe ways in which the food and beverage services sector can address various societal needs *(e.g., by providing wheelchair accessibility, offering menus in Braille, including allergy alerts in menus, offering menu items that meet dietary or health concerns)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. identify and demonstrate compliance with the health and safety legislation, regulations, and practices that govern the food and beverage services sector of the tourism industry;

D2. demonstrate an understanding of the importance of customer service in the food and beverage services sector of the tourism industry;

D3. identify a range of careers in the food and beverage services sector of the tourism industry and the education and training that would best prepare them for these careers.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify the laws, regulations, and regulatory/oversight organizations that govern health, safety, and sanitary standards and practices in the food and beverage services sector *(e.g., Health Protection and Promotion Act [HPPA], Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS] regulations, local health departments)*;

D1.2 identify facilities and equipment in the food and beverage services sector that are required under health and safety legislation and regulations *(e.g., eye wash stations, anti-fatigue mats, hand wash stations, smoke and carbon monoxide detectors, fire-suppression devices, ventilation)*;

D1.3 demonstrate appropriate and timely use of safety and sanitary practices *(e.g., washing hands, wearing hair nets, labelling containers, storing perishable items appropriately, monitoring temperature control)* when handling, preparing, and presenting food and beverages;

D1.4 identify health and safety issues that must be considered in workplaces in the food and beverage services sector *(e.g., issues concerning trip and fall, exposure to chemicals, the effects of fatigue, and workplace ergonomics)*;

D1.5 demonstrate an understanding of emergency preparedness *(e.g., develop an emergency exit plan, ensure all safety equipment is clearly identified and easily accessible)* and procedures to be followed *(e.g., regarding the use of fire-suppression equipment)* in the event of an accident or emergency situation;

D1.6 use protective clothing and equipment as required to ensure their own and others' safety in the work environment.

D2. Customer Service

By the end of this course, students will:

D2.1 identify situations involving customer contact in the food and beverage services sector where positive customer service experiences will enhance a business's reputation *(e.g., greeting customers on arrival, serving food and drink to customers, providing room service)*;

D2.2 identify and describe the fundamental principles of customer service *(e.g., reliability, accountability, caring, responsiveness)*;

D2.3 identify common customer service concerns and describe situations that provide opportunities to meet or exceed the needs or expectations of customers *(e.g., providing professional and friendly table service, responding on the phone or in person to customer questions and/or complaints, accommodating customers with special needs, demonstrating knowledge of and respect for cultural and religious differences, providing advice to guide customer choices)*;

D2.4 describe common ethical standards in customer service in the food and beverage services sector *(e.g., standards relating to privacy, confidentiality, and business ethics)*;

D2.5 explain the importance of uniforms in providing customer service in the food and beverage services sector *(e.g., uniforms help to ensure staff safety and hygiene, enable customers to identify employees, promote the company's image, give staff a professional appearance)*;

D2.6 explain the importance of teamwork in providing high-quality customer service in the food and beverage services sector.

D3. Career Opportunities

By the end of this course, students will:

D3.1 identify the sectors of the tourism industry that are prominent in their local community and/or region and those that are prominent in the province as a whole;

D3.2 identify the factors that may affect incomes in the tourism industry in general and the food and beverage services sector specifically *(e.g., level of education and/or certification, geographical location, the state of the economy)*;

D3.3 identify a variety of careers available in the tourism industry in general and the food and beverage services sector specifically *(e.g., restaurant owner, concierge, travel guide, travel agent, expedition leader, event organizer)*;

D3.4 identify a specific career or careers of interest in the food and beverage services sector *(e.g., restaurant owner or manager, host, chef, caterer)* and describe the secondary school pathways (i.e., selection of courses, programs, and experiential learning opportunities) that would provide the best preparation for these careers;

D3.5 identify industry-recognized training and/or certifications *(e.g., cardiopulmonary resuscitation [CPR], Standard First Aid, Service Excellence, Safe Food Handling)* that it would be beneficial to have if they are pursuing a career in the food and beverage services sector;

D3.6 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the food and beverage services sector *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D3.7 demonstrate an understanding of and apply the Essential Skills that are important for success in the food and beverage services sector, as identified in the Ontario Skills Passport *(e.g., measurement and calculation, oral communication, document use)*;

D3.8 demonstrate an understanding of and apply the work habits that are important for success in the food and beverage services sector, as identified in the Ontario Skills Passport *(e.g., teamwork, reliability, initiative)*;

D3.9 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements related to hospitality and tourism *(e.g., Passport to Safety certificate, Ontario Skills Passport Work Plan, photographs of a project, recipe list, reports, assignments)*, and explain why having a current portfolio is important for career development and advancement.

Hospitality and Tourism, Grade 12

College Preparation

TFJ4C

This course enables students to further develop knowledge and skills related to the various sectors of the tourism industry. Students will demonstrate advanced food preparation and presentation skills; increase health and wellness knowledge; develop tourism administration and management skills; design and implement a variety of events or activities; and investigate principles and procedures that contribute to high-quality customer service. Students will expand their awareness of health and safety issues, environmental and societal issues, and career opportunities in the tourism industry.

Prerequisite: Hospitality and Tourism, Grade 11, College Preparation

A. HOSPITALITY AND TOURISM FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of common management techniques and strategies used in the tourism industry;

A2. demonstrate an understanding of ways in which the various sectors of the tourism industry accommodate the health and wellness needs and try to protect the health and wellness of their customers;

A3. demonstrate an understanding of culinary knowledge as it relates to the tourism industry;

A4. demonstrate an understanding of facilities and equipment used in the various sectors of the tourism industry.

SPECIFIC EXPECTATIONS

A1. Management Techniques and Strategies

By the end of this course, students will:

A1.1 explain the importance of time management skills *(e.g., planning, organizing, delegating tasks, developing schedules)* in running a business in various sectors of the tourism industry;

A1.2 explain how information and communication technology *(e.g., software applications, point-of-sale systems, reservation systems, customer relationship management systems, database marketing)* can be used to effectively meet the needs of customers;

A1.3 identify and describe some of the business strategies *(e.g., franchising, use of loyalty programs, branding, use of destination sales techniques, analysis of tourism and travel trends, up-selling, advertising)* that are used in various sectors of the tourism industry to promote products and services;

A1.4 summarize the necessity for policies and procedures *(e.g., company policy on harassment; emergency protocols – fire, police, ambulance; procedures for dealing with environmental issues such as waste)* to support management objectives in the tourism industry;

A1.5 describe the role of business, labour, associations, and governments in various sectors of the tourism industry *(e.g., with regard to health and safety, industry regulations, career development, workers' insurance, industry promotion, and employee certification)*.

A2. Health and Wellness

By the end of this course, students will:

A2.1 describe the importance of the trend towards healthy eating and living habits *(e.g., as shown by the rise of the Slow Food movement, a greater demand for organic foods and local/seasonal products, changing attitudes towards smoking, the increasing popularity of spa and health resorts)* in terms of its effects on the tourism industry *(e.g., an increasing need to use fresh rather than processed foods and to provide non-smoking accommodations)*;

A2.2 explain how lifestyle, health, and age affect a person's dietary and nutritional needs *(e.g., **lifestyle:** people who are not physically active need fewer calories than those who exercise regularly; **health:** diabetics require a diet that is low in sugar and carbohydrates to keep their blood-sugar level in balance; **age:** women as they age require calcium supplements to combat osteoporosis)*;

A2.3 identify and describe ways in which the tourism industry accommodates the health and wellness needs of customers *(e.g., by making facilities wheelchair accessible, taking measures to protect customers with allergies to certain foods, providing menus in Braille for persons with visual impairments)*;

A2.4 identify and describe ways in which the tourism industry attempts to protect the health and wellness of customers *(e.g., by providing training and certification for responsible serving of alcohol, providing food handling training and certification, providing non-smoking accommodations)*.

A3. Culinary Knowledge

By the end of this course, students will:

A3.1 explain the relationship between various cuisines *(e.g., Aboriginal, halal, kosher, vegan, Thai)* and the service style related to these cuisines;

A3.2 explain how to incorporate nutritional principles in menu planning *(e.g., follow recommendations in Canada's Food Guide and accompanying resources* [Eating Well with Canada's Food Guide *(2007);* Eating Well with Canada's Food Guide: First Nations, Inuit and Métis; *cultural adaptations of Canada's Food Guide available from the Ontario Public Health Association]; prepare food in ways that maximize its nutritional value)*;

A3.3 describe and compare current culinary trends *(e.g., fusion cuisine, Slow Food movement, quick-service and drive-through restaurants, convenience foods, diet food)*;

A3.4 identify physical and/or chemical changes that may occur when food is mixed, cooked, or stored.

A4. Facilities and Equipment

By the end of this course, students will:

A4.1 describe and compare various types of tourism-related facilities *(e.g., hotel, resort, sports and fitness centre, spa, travel agency)* and the equipment they use;

A4.2 outline the appropriate equipment set-up for various events or activities *(e.g., tent for an outdoor wedding reception, equipment arranged in a cafeteria style for a museum, equipment arranged in a cabana style at a resort)*;

A4.3 explain the value of public facilities and buildings, and describe ways in which they can be used for various tourism-related purposes *(e.g., public gardens used for a wedding, government buildings used for a catered event)*.

B. HOSPITALITY AND TOURISM SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. demonstrate a professional level of culinary competence in food preparation and presentation;

B2. demonstrate the ability to follow the best practices of administration and management as they relate to the tourism industry;

B3. demonstrate the ability to successfully market and promote an event or activity;

B4. demonstrate the ability to plan and deliver an event or activity.

SPECIFIC EXPECTATIONS

B1. Food Preparation and Presentation

By the end of this course, students will:

B1.1 demonstrate proficiency in the use of various food preparation methods using dry heat, moist heat, and the combination heat method *(e.g., dry: sauté; moist: poach; combination: braise)*;

B1.2 use measurement tools and equipment to accurately measure the volume and mass of food products in metric, US customary, or British imperial units as appropriate;

B1.3 prepare a variety of culinary products, including appetizers, main courses, and desserts *(e.g., stocks, soups, sauces, sandwiches, salads, meats, fish, cakes, pastries)*, that meet a variety of regular and special dietary needs *(e.g., vegetarian, salt-reduced, religious, cultural)*;

B1.4 use a variety of flavours to enhance the taste of foods *(e.g., herbs, spices, vinegars, oils)*;

B1.5 apply appropriate functional garnishes to a variety of foods *(e.g., croutons for soup, fresh herbs for meats and vegetables, lemon for fish)*, using appropriate culinary techniques that take into account edibility, colour, texture, taste, contrast, and tradition;

B1.6 demonstrate the use of culinary techniques *(e.g., forming an emulsion such as mayonnaise, creating leavening in baked products)* that take into account the physical and chemical changes that occur in food preparation;

B1.7 demonstrate an understanding of the ways in which a standardized recipe helps to control various factors related to food preparation and presentation *(e.g., quality, consistency, cost)*.

B2. Administration and Management Practices

By the end of this course, students will:

B2.1 demonstrate the ability to make individual contributions to overall team performance *(e.g., in a brigade system; as a "front of the house" [serving staff] member, "back of the house" [kitchen staff] member; in sales and/or marketing)*;

B2.2 use appropriate inventory procedures to manage stock effectively *(e.g., monitor expiration dates; use the "first in, first out" [FIFO] method in selecting items from inventory)*;

B2.3 demonstrate the use of appropriate ordering, shipping, and receiving procedures;

B2.4 use appropriate mathematical skills to correctly calculate the cost of food *(e.g., per person, per plate, per event, per recipe)*.

B3. Marketing and Promoting an Event or Activity

By the end of this course, students will:

B3.1 identify various marketing strategies and select one or more appropriate strategies for an event or activity;

B3.2 develop a marketing plan for an event or activity;

B3.3 use a variety of equipment and technologies for a promotional presentation.

B4. Managing an Event or Activity

By the end of this course, students will:

B4.1 identify factors that determine the parameters of an event or activity *(e.g., size, cost, location, timing)* and factors that are critical for its success;

B4.2 develop an action plan that will enable them to successfully stage an event or activity;

B4.3 explain how codes and regulations *(e.g., Special Occasion Permit, fire regulations, labour laws)* affect the delivery of an event or activity;

B4.4 identify the resources and supplies *(e.g., equipment and facilities, consumable products, marketing and promotional resources)* required to manage an event or activity;

B4.5 use computer technology to assist in the design and implementation of an event or activity *(e.g., prepare computer-generated event order sheets, advertising, schedules, brochures, room layout, food costs, travel package)*;

B4.6 coordinate and stage an event or activity, ensuring that it complies with all health and safety laws and regulations;

B4.7 assess the success of an event or activity based on the action plan developed and the outcome, and make recommendations for improvement.

C. INDUSTRY PRACTICES, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of factors that affect the relationship between the tourism industry and the environment;

C2. demonstrate an understanding of factors that affect the relationship between the tourism industry and society.

SPECIFIC EXPECTATIONS

C1. Industry Practices and the Environment

By the end of this course, students will:

C1.1 explain why the tourism industry has a responsibility to protect the environment and encourage the sustainable use of natural resources *(e.g., by reducing, reusing, and recycling waste; by using energy efficiently; by using biodegradable cleaning products)*;

C1.2 analyse how tourism has affected the environment within or outside the local community *(e.g., the effects of increased tourist traffic, increased water use, rising property values)*;

C1.3 identify, through research, an appropriate code of ethics and/or guidelines for sustainable tourism and describe how they could be applied locally and globally;

C1.4 identify and describe ways in which the tourism industry could offset its impact on the environment *(e.g., develop or support a tree planting program, develop or contribute to a carbon offset fund)*.

C2. Industry Practices and Society

By the end of this course, students will:

C2.1 describe, on the basis of research, how the tourism industry has changed in recent years *(e.g., growth in tourist numbers, greater variety of tourist destinations, growing popularity of eco/adventure tourism and culinary tourism)* and explain how these changes have affected local and provincial communities and their economies;

C2.2 explain why tourism businesses have a social responsibility towards the communities in which they are located *(e.g., staff who work in a tourism occupation often live in the community; use of Smart Serve-trained staff to ensure responsible alcohol service and/or provide a shuttle/taxi service for customers can reduce the number of alcohol-related injuries in the community; irresponsible disposal of waste has an adverse effect on the reputation of both the business and the community)*;

C2.3 analyse how technological advances *(e.g., irradiation of food, development of genetically modified foods, use of growth hormones in livestock, use of flavour enhancers, increase in convenience products)* have affected food production and consumer spending;

C2.4 explain how tourism affects the cultural and heritage values of a destination *(e.g., overuse by tourists can damage buildings of cultural significance; status as a tourist attraction helps to protect areas of historic interest)*;

C2.5 describe the function of trade shows and conferences and ways in which they can affect the economy of the communities in which they are held.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and compliance with health and safety standards in the tourism industry and the related legislation and regulations;

D2. demonstrate the ability to provide a professional level of customer service;

D3. describe a range of career opportunities and the education and training required for employment in various sectors of the tourism industry.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 describe the laws, regulations, and regulatory/oversight organizations that govern health, safety, and sanitary standards in the tourism industry (*e.g., Occupational Health and Safety Act [OHSA], Health Protection and Promotion Act [HPPA], Workplace Hazardous Materials Information System [WHMIS] regulations, local health departments*) and explain their importance;

D1.2 analyse the health and safety issues that affect workers in the tourism industry (*e.g., issues concerning exposure to harmful chemicals, the effects of fatigue, ergonomics, sanitation, smoke and carbon monoxide [CO] detectors, fire-suppression devices, ventilation*);

D1.3 handle and store a variety of products (*e.g., cleaning chemicals, raw food products, flammable materials*) according to provincial standards;

D1.4 take sanitary precautions (*e.g., wear gloves, aprons, hair nets*) when and where appropriate;

D1.5 use protective clothing and equipment as required to ensure their own and others' safety in the work environment.

D2. Customer Service

By the end of this course, students will:

D2.1 describe the importance of company policies and procedures in improving or maintaining high-quality customer service;

D2.2 explain the fundamental principles of customer service (*e.g., accountability, caring, reliability, responsiveness*) and apply these principles in delivering an event or activity;

D2.3 explain the importance of showing respect for people with a variety of customer needs (*e.g., people with disabilities, seniors, people from different cultural and religious backgrounds*);

D2.4 identify and describe common ethical standards in customer service (*e.g., standards relating to privacy laws, confidentiality, and business ethics*).

D3. Career Opportunities

By the end of this course, students will:

D3.1 identify trends in the tourism industry (*e.g., the trend towards self-service in booking tickets and making reservations, use of the Internet for comparison shopping of tourism products, more travel by elderly people*) and describe how they affect the demand for jobs in tourism (*e.g., as reflected in employment figures, the labour market index, patterns of seasonal employment*);

D3.2 develop a specific education and training plan for a career in the tourism industry (*e.g., hotel manager, event planner, travel consultant*);

D3.3 identify the provincial and national associations that support the activities of the tourism industry and provide career-related resources (*e.g., Ontario Tourism Education Corporation [OTEC], Ontario Restaurant Hotel and Motel Association, Canadian Tourism Human Resource Council, Canadian Restaurant and Foodservices*

Association, Ontario Society of Nutrition Management, Canadian Culinary Federation, Meeting Professionals International);

D3.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the tourism industry, as identified in the Ontario Skills Passport *(e.g., computer use, job task planning and organizing, finding information);*

D3.5 demonstrate an understanding of and apply the work habits that are important for success in the tourism industry, as identified in the Ontario Skills Passport *(e.g., teamwork, customer service, entrepreneurship);*

D3.6 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements related to hospitality and tourism *(e.g., Passport to Safety certificate, Ontario Skills Passport Work Plan and Transition Plan, photographs of participation in a successful event or activity, event plan, recipe catalogue)*, and explain why having a current portfolio is important for career development and advancement.

Hospitality and Tourism, Grade 12

Workplace Preparation   TFJ4E

This course enables students to further develop knowledge and skills related to the food and beverage services sector of the tourism industry. Students will demonstrate proficiency in using food preparation and presentation tools and equipment; plan nutritious menus, create recipes, and prepare and present finished food products; develop customer service skills; and explore event and activity planning. Students will expand their awareness of health and safety practices, environmental and societal issues, and career opportunities in the food and beverage services sector.

Prerequisite: Hospitality and Tourism, Grade 11, Workplace Preparation

A. HOSPITALITY AND TOURISM FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of factors that affect the tourism industry in general and the food and beverage services sector specifically;

A2. explain the importance and value of a well-balanced and nutritious meal plan;

A3. handle and store foods in compliance with the Health Protection and Promotion Act (HPPA);

A4. demonstrate an understanding of various types of facilities and equipment used in the food and beverage services sector of the tourism industry.

SPECIFIC EXPECTATIONS

A1. Factors Affecting the Tourism Industry

By the end of this course, students will:

A1.1 identify and describe factors that contribute to the growth of the tourism industry *(e.g., development and improvement of tourist facilities, technological advances such as Internet reservation systems, favourable exchange rates, an increase in disposable income, the expansion of a middle class in developing countries, the promotion of international festivals and sporting events)*;

A1.2 describe how tourist attractions benefit the local and/or provincial food and beverage services sector *(e.g., areas close to museums, theatres, and scenic attractions are good locations for restaurants, cafés, and bars)*;

A1.3 describe important considerations for food and beverage servers when delivering room service professionally to guests in hotels and other lodging properties *(e.g., food and/or beverages are at the appropriate temperature; delivery is timely; presentation of food and/or beverages is appropriate)*;

A1.4 identify and describe factors that contribute to the success of businesses in the food and beverage services sector *(e.g., attractive or convenient location, good-quality products at competitive prices, prompt and attentive service, relaxing atmosphere)*.

A2. Planning Nutritious Meals

By the end of this course, students will:

A2.1 describe the essential principles of nutrition as referenced in Canada's Food Guide and accompanying resources *(e.g., Eating Well with Canada's Food Guide [2007]; Eating Well with Canada's Food Guide: First Nations, Inuit and Métis; cultural adaptations of Canada's Food Guide available from the Ontario Public Health Association)*;

A2.2 identify various food products and cuisines from around the world and assess the nutritional value of various popular dishes using appropriate resources *(e.g., Eating Well with Canada's Food Guide [2007]; Eating Well with Canada's Food Guide: First Nations, Inuit and Métis; cultural adaptations of Canada's Food Guide available from the Ontario Public Health Association)*;

A2.3 describe the effect of food-processing techniques *(e.g., freezing, pickling, grinding, thawing)* on the nutritional value of food;

A2.4 identify the differences *(e.g., with respect to yield, nutrition, freshness, taste)* between locally grown and/or organically grown fruits and vegetables and those grown using traditional cultivation techniques *(e.g., use of fertilizer and pesticides)* and/or harvested unripe and transported long distances;

A2.5 identify ways in which lifestyle, health, and age affect a person's dietary and nutritional needs *(e.g., **lifestyle:** people who are not physically active need fewer calories than those who exercise regularly; **health:** diabetics require a diet that is low in sugar and carbohydrates to keep their blood-sugar level in balance; **age:** women as they age require calcium supplements to combat osteoporosis);*

A2.6 create a meal plan that incorporates the essential principles of nutrition and explain how it provides a nutritious, well-balanced diet;

A2.7 explain why dietary supplements are added in the production of various foods *(e.g., to supply nutrients [vitamins, minerals, fatty acids, amino acids] that are missing from or not consumed in sufficient quantities in a person's diet).*

A3. Food Handling and Storage

By the end of this course, students will:

A3.1 demonstrate the use of safe food handling and proper sanitation practices *(e.g., prevent cross-contamination of foods, keep their person and uniform clean, wear hair nets, observe good housekeeping practices);*

A3.2 apply provincial standards for safe food handling when preparing food *(e.g., wear gloves, use different-coloured cutting boards for different foods);*

A3.3 demonstrate professional food storage practices *(e.g., label containers; apply the "first in, first out" method when selecting food products for use);*

A3.4 demonstrate effective management of resources and inventory *(e.g., in terms of portion control, waste management, and energy conservation);*

A3.5 identify the causes of food-borne illnesses *(e.g., salmonella, Norwalk virus, E. coli),* the associated medical symptoms *(e.g., nausea, stomach cramps, fever),* and methods of prevention *(e.g., store, handle, and cook food appropriately).*

A4. Facilities and Equipment

By the end of this course, students will:

A4.1 identify the characteristics of various types of facilities *(e.g., health spa, hotel, resort, bed and breakfast operation, country club)* that include food and beverage services as part of the services they provide;

A4.2 describe ways in which the food and beverage services sector can take advantage of community facilities to host an activity or event *(e.g., catering a banquet at the local arena, holding receptions at a community centre);*

A4.3 list the main types of equipment needed to operate different types of food service operations *(e.g., quick-service outlet, diner, restaurant, banquet hall);*

A4.4 describe how various types of equipment are used in the food and beverage services sector *(e.g., barbecues for grilling food outdoors, insulated carriers for transporting frozen food, chafing dishes for keeping food warm at a buffet).*

B. HOSPITALITY AND TOURISM SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. demonstrate technical proficiency in the use and maintenance of tools and equipment related to the food and beverage services sector of the tourism industry;

B2. plan and prepare menus, demonstrating a level of competence in food handling, preparation, and presentation that meets professional standards;

B3. demonstrate an understanding of appropriate procedures to follow in the planning and delivery of an event or activity.

SPECIFIC EXPECTATIONS

B1. Using Tools and Equipment

By the end of this course, students will:

B1.1 demonstrate proficiency when using a variety of tools and equipment related to the food and beverage services sector (*e.g., electric mixers, ovens, knives*);

B1.2 use a variety of measuring tools to accurately determine, in metric, US customary, or British imperial units as appropriate, the weight and/or volume of ingredients for meal preparation and, in degrees Celsius or Fahrenheit, the cooking temperature required;

B1.3 maintain tools and equipment related to the food and beverage services sector in a professional manner (*e.g., keep knives sharp, keep workstations clean and organized, store tools properly*).

B2. Food Preparation and Presentation

By the end of this course, students will:

B2.1 apply Health Protection and Promotion Act (HPPA) standards in handling, storing, and preparing food products (*e.g., cook and/or store food at the proper tempurature; apply the "first in, first out" [FIFO] method in selecting ingredients*);

B2.2 perform accurate conversions and calculations of yield (i.e., the number of persons who can be served) for various types of recipes, using metric, US customary, or British imperial units as appropriate;

B2.3 perform accurate calculations of yield as it relates to "as raw product purchased" and "edible portion", and explain how the relationship between the two calculations affects cost and profitability;

B2.4 prepare a variety of food products (*e.g., appetizer, main course, dessert, hot and cold beverages*) according to recipe specifications;

B2.5 prepare a variety of international recipes in accordance with the culinary traditions of various cultures (*e.g., Aboriginal, Thai, French, Italian*);

B2.6 prepare complex recipes accurately using readily available ingredients;

B2.7 present food products appropriately for a variety of purposes (*e.g., buffet, à la carte*);

B2.8 set a table in a professional and creative manner (*e.g., paying attention to the choice and arrangement of utensils and glassware, the design of the centrepiece, the way napkins are folded*) to suit the circumstances (*e.g., fine dining, wedding, banquet*);

B2.9 demonstrate the use of professional waiting techniques when serving beverages (*e.g., taking and delivering orders, providing tea and coffee service, serving and clearing from the right*).

B3. Planning and Delivering an Event or Activity

By the end of this course, students will:

B3.1 create an action plan for an event or activity and outline the designated role of each participant in the staging of the event or activity;

B3.2 design, plan, and promote an activity or fundraiser, individually or as part of a team, using a variety of software applications;

B3.3 coordinate and stage an event or activity individually or as part of a team;

B3.4 use teamwork and organizational skills to complete a variety of tasks in the coordination and/or staging of an event or activity;

B3.5 analyse the success of an event or activity in relation to its action plan *(e.g., have a formal debriefing using a plus/delta format)*.

C. INDUSTRY PRACTICES, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of how various practices connected with the tourism industry in general and the food and beverage services sector specifically affect the environment, and how these effects can be reduced;

C2. demonstrate an understanding of ways in which various practices connected with the tourism industry in general and the food and beverage services sector specifically affect society.

SPECIFIC EXPECTATIONS

C1. Industry Practices and the Environment

By the end of this course, students will:

C1.1 identify the effects that the tourism industry has on the environment (*e.g., undeveloped areas exploited for commercial gain, environmentally sensitive areas affected by pollution and waste disposal, infrastructure expanded and upgraded, areas of natural beauty preserved as tourist attractions*);

C1.2 describe how the food and beverage services sector can both protect the environment and encourage the sustainable use of natural resources (*e.g., by choosing new locations on or near existing infrastructure to reduce the need for new infrastructure, providing guests with the option not to have linens washed daily, composting organic waste from restaurants, reusing cooking oil as a biofuel, using locally grown produce to reduce the need for long-distance transportation*);

C1.3 identify, through research, an appropriate code of ethics and/or guidelines for sustainable tourism and describe how they could be applied to the operation of local food and beverage services facilities;

C1.4 identify ways in which the food and beverage services sector could offset its impact on the environment (*e.g., develop or support a tree planting program, develop or contribute to a carbon offset fund*).

C2. Industry Practices and Society

By the end of this course, students will:

C2.1 explain the importance of the tourism industry at the local level (*e.g., tourism can support local economies, create local jobs, preserve local culture, and/or provide funds for infrastructure development and social and recreational programs*);

C2.2 explain how food and beverage services facilities benefit the local job market (*e.g., by creating a range of entry-level jobs, providing experiential learning opportunities in hospitality and tourism-related businesses, having a ripple effect on other areas of the job market*);

C2.3 describe how tourism can affect the culture of a society (*e.g., tourist attitudes and behaviour can over time erode local customs and traditions and/or cause resentment among the local population*).

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and compliance with health and safety legislation and regulations and the practices that are essential for a safe and healthy work environment;

D2. demonstrate an understanding of strategies and techniques that provide a positive customer service experience;

D3. describe the range of career opportunities and the education and training required for employment in the food and beverage services sector of the tourism industry.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 describe the laws, regulations, and regulatory/oversight organizations that govern health, safety, sanitation, and workers' rights in the food and beverage services sector of the tourism industry *(e.g., Health Protection and Promotion Act [HPPA], Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS] regulations, Workplace Safety and Insurance Board [WSIB], local health departments)*;

D1.2 identify and describe health and safety issues that must be considered in workplaces in the food and beverage services sector *(e.g., issues concerning trip and fall, exposure to chemicals, the effects of fatigue, and workplace ergonomics)*, and explain how these issues affect working conditions;

D1.3 identify ways of meeting health and safety requirements and recommendations *(e.g., concerning public safety)* in various settings of the food and beverage services sector *(e.g., carry out food inspections; have an emergency preparedness fire/evacuation plan; maintain a clean, hygienic facility; provide separate washrooms for staff and customers; observe municipal by-laws)*;

D1.4 demonstrate the ability to follow health and safety best practices *(e.g., report unsafe working conditions in the school classroom/facility; use WHMIS data sheets and understand WHMIS safety cautions; know appropriate first aid*

procedures to be used in the event of an accident such as a burn, cut, or electric shock);

D1.5 use protective clothing and equipment as required to ensure their own and others' safety in the work environment.

D2. Customer Service

By the end of this course, students will:

D2.1 apply intrapersonal and interpersonal skills to provide a professional level of customer service;

D2.2 outline the benefits of providing a positive customer experience *(e.g., reputation of the business enhanced, customer base maintained or expanded, viability of the business increased)*;

D2.3 explain the need for sensitivity in responding to client needs *(e.g., explain why knowledge of and respect for various cultures, religions, and people with disabilities are important in providing customer service)*;

D2.4 assess various strategies used by companies to retain and grow their customer base *(e.g., providing a unique environment or service, offering customers a points-accumulation system and/or prizes, holding customer appreciation days)*;

D2.5 demonstrate an understanding of the use of ethical standards in customer service *(e.g., standards relating to privacy, confidentiality, and business ethics)*.

D3. Career Opportunities

By the end of this course, students will:

D3.1 outline job opportunities, career paths, and educational requirements for careers in the food and beverage services sector of the tourism industry;

D3.2 describe the lifestyle and personal choices that can accompany a career in the food and beverage services sector *(e.g., shift work, seasonal work, travel)*;

D3.3 identify industry-recognized training and/or certifications *(e.g., Service Excellence, Super Host, Safe Food Handling, Smart Serve)* that it would be beneficial to have if they are pursuing a career in the food and beverage services sector;

D3.4 identify the provincial and national associations that support the activities of the tourism industry and provide career-related resources *(e.g., Ontario Tourism Education Corporation [OTEC], Ontario Restaurant Hotel and Motel Association, Canadian Tourism Human Resource Council, Canadian Restaurant and Foodservices Association, Ontario Society of Nutrition Management, Canadian Culinary Federation, Meeting Professionals International)*;

D3.5 demonstrate an understanding of and apply the Essential Skills that are important for success in the food and beverage services sector, as identified in the Ontario Skills Passport *(e.g., scheduling or budgeting and accounting, measurement and calculation, job task planning and organizing)*;

D3.6 demonstrate an understanding of and apply the work habits that are important for success in the food and beverage services sector, as identified in the Ontario Skills Passport *(e.g., teamwork, reliability, customer service)*;

D3.7 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements related to hospitality and tourism *(e.g., Ontario Skills Passport Work Plan and Transition Plan, certificates, reports, photographs, recipe catalogue)*, and explain why having a current portfolio is important for career development and advancement.

MANUFACTURING TECHNOLOGY

Manufacturing is the transformation of materials into products to meet human needs and wants. Manufacturing technology courses provide students with opportunities to acquire knowledge and skills in the areas of mechanical engineering, robotics and control systems, computer-aided manufacturing, industrial maintenance, precision machining, welding, and sheet metal.

Students will use a broad range of tools and equipment while acquiring engineering, fabrication, and problem-solving skills through the design and fabrication of various projects. Manufacturing courses will also help students understand the effects of manufacturing technology on the environment and society.

Manufacturing courses are designed for students heading to an apprenticeship, to college or university, or directly to the workplace in their pursuit of careers such as tradesperson, technician, technologist, engineer, or any of the skilled entry positions.

The list of approved emphasis areas for manufacturing technology can be found at www.edu.gov.on.ca/eng/curriculum/secondary/teched.html.

- Courses in technological education are suitable for use in cooperative education programs and in connection with other forms of experiential learning as well as in programs such as the Specialist High Skills Major (SHSM). For more information, see pages 43–44 of this document.
- For policy guidelines pertaining to multiple-credit courses and emphasis courses, see pages 17–18 of this document.

Manufacturing Engineering Technology, Grade 11

University/College Preparation   **TMJ3M**

This course enables students to develop knowledge and skills related to design, process planning, control systems, and quality assurance. Students will use a broad range of tools and equipment and will combine modern manufacturing techniques and processes with computer-aided manufacturing as they develop critical decision-making, problem-solving, and project-management skills. Students will develop an awareness of environmental and societal issues related to manufacturing and will learn about pathways leading to careers in the industry.

Prerequisite: None

A. MANUFACTURING TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of design and other problem-solving processes used to develop solutions and products in response to challenges in manufacturing technology;

A2. demonstrate an understanding of the steps and processes required to produce a product;

A3. demonstrate an understanding of various types of control systems used in manufacturing;

A4. apply relevant mathematical skills, scientific concepts, and technological literacy and communication skills in developing a manufacturing system or process.

SPECIFIC EXPECTATIONS

A1. Design Process

By the end of this course, students will:

A1.1 describe and explain the importance of the steps of a design process *(e.g., analysing the situation or context, developing design criteria, generating ideas, conducting research, communicating ideas, choosing the best solution, building a prototype, testing and modifying the prototype, undertaking a cost analysis)* or other problem-solving process used to solve a variety of manufacturing technology challenges *(e.g., use a problem-solving matrix for a robotics-related challenge arising from the production of the prototype)* (see pp. 21–23);

A1.2 use technical drawings *(e.g., orthographic, pictorial, isometric, assembly)* as part of the design process to develop solutions to challenges or problems in manufacturing technology;

A1.3 explain why technological concepts *(e.g., aesthetics, control, environmental sustainability/ stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems)* are important considerations in the design process (see pp. 7–8);

A1.4 explain how the application of technological concepts in design or other problem-solving processes can result in products that better meet human needs or wants *(e.g., a ramp to replace a stairway, a lever-type door handle to replace a round knob, a remote control to operate a television, energy-efficient devices to replace inefficient ones).*

A2. Process Planning

By the end of this course, students will:

A2.1 explain the need for a detailed production plan when manufacturing a product;

A2.2 identify and analyse the factors that must be considered when planning production *(e.g., quantity, tolerances, cost factors)*;

A2.3 explain the differences in planning for custom-build versus mass-production processes;

A2.4 apply collaborative problem solving to plan a detailed product manufacturing process *(e.g., including details of work flow, just-in-time part routing, scheduling, timelines, deadlines, efficient use of materials).*

A3. Control Systems

By the end of this course, students will:

A3.1 describe various types of control systems *(e.g., programmable logic control [PLC], computer numerical control [CNC], inventory/purchasing control)*;

A3.2 incorporate the use of a control system *(e.g., Program Evaluation and Review Technique [PERT] chart, Gantt chart)* in a production process or project;

A3.3 explain how a quality control system *(e.g., statistical process control, standards developed by the International Organization for Standardization [ISO])* is used to manage production;

A3.4 utilize automation technology *(e.g., program-mable logic controller [PLC], computer-aided manufacturing [CAM], pneumatic actuators)* to control a process.

A4. Mathematics, Science, and Technological Literacy

By the end of this course, students will:

A4.1 apply mathematical skills *(e.g., calculate production rates, machine speeds and feeds, ratios; use formulas related to geometry and trigonometry; estimate costs)* in planning manufacturing processes;

A4.2 apply scientific concepts to manufacturing-related processes *(e.g., material selection, material processing, setting of machining speed and cutting force)*;

A4.3 apply technological literacy skills to create process control charts that clearly outline the stages of production;

A4.4 prepare engineering reports *(e.g., flow charts, inspection reports, tool lists, schedules, build plans)*, using appropriate technical language to communicate the specifics of a product or process.

B. MANUFACTURING TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. identify and use appropriate processes to organize and control the manufacturing of products;

B2. demonstrate an understanding of the appropriate selection of materials to manufacture products to meet specific needs;

B3. demonstrate the safe and appropriate use of tools and equipment in the manufacture of a product or the development of a production process;

B4. analyse, properly operate, and maintain quality in a manufacturing system or process.

SPECIFIC EXPECTATIONS

B1. Managing the Manufacturing Process

By the end of this course, students will:

B1.1 select the most efficient production method or process to manufacture a product;

B1.2 develop managerial and mechanical control plans (*e.g., **managerial:** marketing, production tracking, financial control, inventory control, work-in-process tracking; **mechanical control:** electrical, pneumatic*) for the manufacture of a product (*e.g., robot, control system*);

B1.3 implement managerial and mechanical control plans for the manufacture of a product;

B1.4 use appropriate orthographic and isometric drawing techniques (*e.g., sketching, computer-aided design [CAD]*) when developing solutions to design problems or challenges.

B2. Material Selection

By the end of this course, students will:

B2.1 demonstrate an understanding of destructive and non-destructive tests to evaluate material properties (*e.g., file test, spark test, moisture content test, dye testing, hardness testing*);

B2.2 evaluate material properties (*e.g., heat resistance, mass, strength*) as they relate to specific project needs;

B2.3 research and evaluate the properties of various ferrous and non-ferrous materials before selecting the most appropriate material for a project;

B2.4 demonstrate a working knowledge of the methods of conditioning materials (*e.g., thermal, chemical, mechanical methods*).

B3. Tools, Equipment, and Manufacturing Processes

By the end of this course, students will:

B3.1 select and use the proper tools (*e.g., height gauge, surface gauge, trammel points, protractor, scriber*) and procedures required to effectively lay out a project;

B3.2 demonstrate the proper use of various measuring instruments (*e.g., scale, vernier caliper, micrometer*), making measurements in both metric and US customary/British imperial units;

B3.3 demonstrate the safe and proper use of appropriate hand tools, machine tools, and equipment (*e.g., files, wrenches, hack saws, electric drills, engine lathe, milling machine, planer, jointer, drill press, welder*) during a manufacturing process or in the assembly or fabrication of a product;

B3.4 use a computer to operate and control a manufacturing system (*e.g., a robot, computer numerical control [CNC] equipment, a programmable logic control [PLC] device*) during a manufacturing process or in the fabrication of a project.

B4. Quality Assurance

By the end of this course, students will:

B4.1 analyse and explain production results in a manufacturing process *(e.g., by preparing a quality report)*;

B4.2 use a quality control method *(e.g., statistical process control)* to monitor and record the reliability of a manufacturing process;

B4.3 explain how positive and negative attitudes influence production efficiency.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of ways in which the manufacturing industry affects the environment;

C2. demonstrate an understanding of ways in which the manufacturing industry affects society.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 analyse the effects that various manufacturing activities have on the environment *(e.g., the effects of waste disposal, power consumption, processing of raw materials; effects on Aboriginal hunting and gathering grounds)*;

C1.2 explain the benefits of using environmentally friendly processes and products in the manufacturing process;

C1.3 explain how various sources of power generation *(e.g., coal, nuclear, wind, solar, geothermal)* and transportation methods *(e.g., truck, rail, ship)* used in manufacturing affect the environment.

C2. Technology and Society

By the end of this course, students will:

C2.1 describe the social and economic consequences that a manufacturing activity can have or has had on individuals and society, including Aboriginal communities;

C2.2 explain how the manufacturing industry affects the local and provincial economy *(e.g., with respect to job creation, standards of living, sustainability and conservation of the environment, impact on First Nation communities)*;

C2.3 describe recent trends in the local manufacturing industry *(e.g., globalization, rise in energy costs, increase in environmental awareness)* and their effect on the local community or the province as a whole, and predict future trends.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and compliance with the health and safety legislation, standards, and practices that are essential to the safe operation of a manufacturing facility;

D2. demonstrate an understanding of postsecondary pathways that lead to career opportunities in the manufacturing industry.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify and explain the importance of the specific components of legislation and standards related to workplace safety in the manufacturing industry *(e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS])* and the specific responsibilities of the relevant oversight/regulatory organizations *(e.g., Workplace Safety and Insurance Board [WSIB], Industrial Accident Prevention Association [IAPA])*;

D1.2 demonstrate good housekeeping practices in the work environment *(e.g., cleaning up spills and leaks, keeping areas clean and clear of obstructions, properly organizing tools and equipment)*;

D1.3 handle materials safely and appropriately in compliance with the information included in the Material Safety Data Sheets (MSDS) from the Workplace Hazardous Materials Information System (WHMIS);

D1.4 demonstrate an understanding of procedures to ensure safe and productive work practices in the manufacturing workplace *(e.g., perform safety inspections and audits that include ergonomic considerations related to workshop layout and set-up, material handling, ease of movement, lighting, workstation set-up)*;

D1.5 demonstrate the safe use of tools and equipment in compliance with safety manuals, instructions, and institutional requirements;

D1.6 use proper ventilation and/or filtration systems to control air quality *(e.g., to minimize the effects of welding fumes, plastic off-gassing, cutting-fluid misting, heat treating of metal)*;

D1.7 use protective clothing and equipment as required to ensure their own and others' safety in the work environment.

D2. Career Opportunities

By the end of this course, students will:

D2.1 identify employment opportunities available in the manufacturing industry locally, provincially, and nationally;

D2.2 identify and describe the specific education and training requirements necessary for careers in the manufacturing industry *(e.g., technician, technologist, millwright, tool and die maker, mechanical engineer)*;

D2.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the manufacturing industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the manufacturing industry, as identified in the Ontario Skills Passport *(e.g., decision making, job task planning and organizing, problem solving)*;

D2.5 demonstrate an understanding of and apply the work habits that are important for success in the manufacturing industry, as identified in the Ontario Skills Passport *(e.g., teamwork, reliability, initiative)*;

D2.6 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in manufacturing technology *(e.g., Passport to Safety certificate, Ontario Skills Passport Work Plan, photographs of a project, technical drawings, reports, assignments)*, and explain why having a current portfolio is important for career development and advancement.

Manufacturing Technology, Grade 11

College Preparation   TMJ3C

This course enables students to develop knowledge and skills through hands-on, project-based learning. Students will acquire design, fabrication, and problem-solving skills while using tools and equipment such as lathes, mills, welders, computer-aided machines, robots, and control systems. Students may have opportunities to obtain industry-standard certification and training. Students will develop an awareness of environmental and societal issues related to manufacturing and will learn about pathways leading to careers in the industry.

Prerequisite: None

A. MANUFACTURING TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of how a design process is used in the planning and development of a manufacturing project;

A2. demonstrate an understanding of material conversion processes;

A3. demonstrate an understanding of various types of control systems used in manufacturing;

A4. apply relevant mathematical and scientific concepts and use appropriate forms of technical communication in the study of manufacturing technology.

SPECIFIC EXPECTATIONS

A1. Design Process

By the end of this course, students will:

A1.1 describe and explain the importance of the steps in a design process *(e.g., analysing the situation, defining the need or problem, conducting research, generating solutions, communicating ideas, evaluating solutions, building a prototype, undertaking a cost analysis)* or other problem-solving process used to solve a variety of manufacturing technology challenges *(e.g., design and plan the fabrication of a robot or robotic work cell to specific design criteria and timelines)* (see pp. 21–23);

A1.2 describe some examples of how the design process has been used in manufacturing to develop new products, or to improve existing products, to meet human needs or wants *(e.g., quality of automobiles improved through the use of robotics in the manufacturing process)*;

A1.3 explain why technological concepts *(e.g., aesthetics, control, environmental sustainability/ stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems)* are important considerations in the design process (see pp. 7–8);

A1.4 use brainstorming strategies, web diagrams, and trial-and-error activities as part of the design process to develop the best possible solution to a manufacturing challenge.

A2. Material Conversion

By the end of this course, students will:

A2.1 describe and demonstrate the correct use of a variety of processes for joining materials *(e.g., welding, bonding, fastening)*;

A2.2 describe and demonstrate the correct use of a variety of processes for cutting materials *(e.g., using oxy-acetylene torches, saws, shears, a plasma cutter, an engine lathe, a milling machine)*;

A2.3 describe and demonstrate the correct use of a variety of processes for forming materials, using various tools and equipment *(e.g., hammers; brake press; rollers; forging, casting, and moulding equipment)*;

A2.4 describe material conversions such as the separation process *(e.g., converting a material's size and shape by removing excess material)*; the addition process *(e.g., combining materials to achieve enhanced qualities, as in alloys)*; the process of making changes to contours *(e.g., assembling materials by such means as gluing, mixing, fastening, bonding, welding)*; and the process of changing the properties *(e.g., thermal, chemical, mechanical, physical)* of solid materials;

A2.5 demonstrate a working knowledge of converting the structure of a material, using a variety of methods *(e.g., heat treating, annealing, steaming, shrinking, tempering)*.

A3. Control Systems

By the end of this course, students will:

A3.1 describe various manufacturing control systems *(e.g., inventory/purchasing control, quality control)*;

A3.2 explain the use of control system technologies *(e.g., electronic – programmable logic controller [PLC]; hydraulic; mechanical; pneumatic)* in a production process or project;

A3.3 operate a basic control system *(e.g., electronic, pneumatic, hydraulic, mechanical)* to control a robot or component in completing a simple task.

A4. Mathematics, Science, and Communication Skills

By the end of this course, students will:

A4.1 demonstrate a working knowledge of various mathematical formulas *(e.g., Pythagorean theorem, formulas for calculating volume and surface area)* and applications *(e.g., tap drill sizing, calculation of machine speeds and feeds, weight calculations)* that are commonly used in manufacturing;

A4.2 apply mathematical concepts *(e.g., linear systems; integers; decimals and fractions; order of operations)* and skills in performing a variety of tasks required within the context of manufacturing design and production *(e.g., angle calculations; calculation of perimeter, volume, and area; percent/decimal/fraction conversions; US customary/ British imperial and metric unit conversions)*;

A4.3 apply mathematical analysis skills as they relate to production cost and quality control when manufacturing a product *(e.g., conduct a cost analysis of the final product or process, produce statistical process control charts)*;

A4.4 apply scientific laws, theories, and concepts related to the design and production areas of manufacturing *(e.g., **laws/theories:** Newton's laws of motion, basic electrical theory; **concepts:** simple machines, mechanical advantage)*;

A4.5 identify the properties *(e.g., magnetic, physical, mechanical, thermal, electrical)* of natural and manufactured solid materials;

A4.6 describe how the physical and mechanical properties of solid materials *(e.g., **physical:** density, appearance, porosity, surface texture; **mechanical:** hardness, ductility, elasticity, brittleness, compression, fatigue, shear, tensility)* create advantages or disadvantages that affect their suitability for use in manufacturing;

A4.7 use technical language correctly and appropriately *(e.g., in reports and presentations)* to communicate information related to manufacturing technology;

A4.8 use appropriate forms of communication *(e.g., oral and written reports)* and supporting documentation *(e.g., statistical graphing; sketches; scale drawings; perspectives; orthographic, isometric, and oblique views; pattern and development projections; shop, assembly, and detail drawings)* to convey ideas and processes and to show materials and specifications.

B. MANUFACTURING TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. demonstrate the ability to interpret and prepare technical drawings and develop process plans;

B2. demonstrate a working knowledge of the characteristics of various materials and the proper selection of materials for the manufacture of a product;

B3. demonstrate a working knowledge of various metrology tools used to measure, lay out, and inspect products;

B4. use tools, equipment, and machine processes safely and correctly in the manufacture of a product.

SPECIFIC EXPECTATIONS

B1. Technical Drawings and Process Plans

By the end of this course, students will:

B1.1 demonstrate a working knowledge of the stages of the manufacturing process *(e.g., produce an order of operation chart, develop a bill of material for a project, undertake a cost analysis, develop a process plan)*;

B1.2 use appropriate language and terminology *(e.g., in oral and written reports)* when developing process plans;

B1.3 convert drawing dimensions *(e.g., US customary/British imperial units to metric units, fractions to decimals)* using the appropriate chart, table, or formula;

B1.4 prepare, using conventional means or computer-aided design (CAD), detailed working drawings and/or assembly drawings or rough sketches *(e.g., section views, isometric views)*, as appropriate to the task, that include the measurements and symbols required to complete a project *(e.g., dimensions, specifications, tolerances, surface finish symbols, weldments)*.

B2. Material Characteristics and Selection

By the end of this course, students will:

B2.1 identify the factors that affect material selection and suitability for the manufacture of a product *(e.g., hardness, softness, malleability, mass, durability, shape, size, finish)*;

B2.2 select appropriate materials for a project based on their properties and characteristics *(e.g., physical, mechanical, thermal, chemical, electrical, magnetic, optical, acoustical)* and the project's design criteria *(e.g., strength, finish, customer specifications, quality control processes, working environment)*;

B2.3 use the proper procedures to prepare materials for production *(e.g., measuring, marking, cutting to rough length, grinding, cleaning, deburring)*.

B3. Metrology Tools

By the end of this course, students will:

B3.1 demonstrate the correct use of various measuring instruments *(e.g., scales, vernier calipers, micrometers, gauges)* to make measurements in both metric and US customary/British imperial units;

B3.2 apply principles of dimensional metrology *(e.g., precision measurement, tolerancing for interchangeable manufacturing)* to manufacturing processes when producing a product;

B3.3 demonstrate a working knowledge of the proper tools required to lay out a product precisely *(e.g., height gauge, surface gauge, trammel points, protractor, scribe, straight edge)*;

B3.4 use metrology tools to inspect and evaluate products for quality control purposes *(e.g., for inspection reports, destructive and non-destructive testing)*.

B4. Tools, Equipment, and Machine Processes

By the end of this course, students will:

B4.1 demonstrate the use of appropriate bench work techniques to lay out, fit, and assemble workpieces;

B4.2 use appropriate procedures *(e.g., correct machine set-up, operational safety procedures)* when setting up, maintaining, using, and storing tools and equipment used in manufacturing and production processes;

B4.3 demonstrate the correct selection and use of appropriate tools and equipment *(e.g., wrenches, electric drills, grinders, engine lathe, milling machine)* for specific manufacturing tasks;

B4.4 demonstrate the use of various bonding, combining, and/or assembly techniques *(e.g., shielded metal arc welding [SMAW], gas metal arc welding [GMAW], gas tungsten arc welding [GTAW], oxy-acetylene welding, brazing, soldering, use of appropriate fasteners, bonding)* to complete projects.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of ways in which the manufacturing industry affects the environment;

C2. demonstrate an understanding of ways in which the manufacturing industry affects society.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 describe the benefits of using environmentally friendly products in the manufacturing process *(e.g., the benefits of water-based versus solvent-based adhesives);*

C1.2 identify a variety of alternative fuels *(e.g., biodiesel, ethanol, hydrogen, electric power in hybrid systems)* and energy sources *(e.g., wind power, solar power, waste-to-energy)* and explain how use of these fuels and energy sources can reduce the environmental impact of the manufacturing industry;

C1.3 explain how various sources of power generation used in manufacturing *(e.g., coal, nuclear, solar, wind, hydrogen fuel cell, tidal, geothermal)* affect the environment *(e.g., construction of large hydroelectric dams can affect animal habitats and patterns of behaviour);*

C1.4 describe environmentally responsible practices that can be followed during the design and manufacture of a product *(e.g., minimize waste, consider using renewable or recyclable materials, design and manufacture products that last or can be repaired as opposed to throw-away products, use processes that have minimal impact on workers and the local environment);*

C1.5 demonstrate the use of proper techniques for the disposal of waste products.

C2. Technology and Society

By the end of this course, students will:

C2.1 explain how the manufacturing industry affects the local and provincial economy *(e.g., with respect to job creation, standards of living, sustainability and conservation of the environment, impact on First Nation communities);*

C2.2 describe how the manufacturing industry responds to changes in the global economy *(e.g., fluctuating currencies, trade agreements, fluctuating demand in other countries)* and how this response affects the local community and/or the province as a whole *(e.g., in terms of economic opportunities or risks for the local and/or provincial population);*

C2.3 explain how ergonomics and a good manufacturing work environment can affect people's daily lives *(e.g., by providing long-term health benefits, creating job efficiencies).*

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and compliance with health and safety legislation, standards, and practices related to the manufacturing industry;

D2. demonstrate an understanding of career opportunities in the manufacturing industry and the education, training, and certification required for these careers.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify and explain the importance of the specific components of legislation and standards related to workplace safety in the manufacturing industry *(e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS])* and the specific responsibilities of the relevant oversight/regulatory organizations *(e.g., Workplace Safety and Insurance Board [WSIB], Industrial Accident Prevention Association [IAPA], Construction Safety Association of Ontario [CSAO])*;

D1.2 demonstrate good housekeeping practices in the work environment *(e.g., cleaning up spills and leaks, keeping areas clean and clear of obstructions, properly organizing tools and equipment)*;

D1.3 handle materials safely and appropriately in compliance with the information included in the Material Safety Data Sheets (MSDS) from the Workplace Hazardous Materials Information System (WHMIS);

D1.4 demonstrate an understanding of procedures to ensure safe and productive work practices in the manufacturing workplace *(e.g., perform safety inspections and audits that include ergonomic considerations related to workshop layout and set-up, material handling, ease of movement, lighting, workstation set-up)*;

D1.5 demonstrate the safe use of tools and equipment in compliance with safety manuals, instructions, and institutional requirements;

D1.6 use proper ventilation systems to control air quality *(e.g., to minimize the effects of welding fumes, plastic off-gassing, cutting-fluid misting, heat treating of metal)*;

D1.7 use protective clothing and equipment as required to ensure their own and others' safety in the work environment.

D2. Career Opportunities

By the end of this course, students will:

D2.1 identify employment opportunities available in the manufacturing industry locally, provincially, and nationally;

D2.2 identify manufacturing-related college programs and apprenticeships that are available in the manufacturing industry prior to or immediately following graduation;

D2.3 identify opportunities available locally to obtain certifications and/or training that it would be beneficial to have if they are pursuing a career in manufacturing *(e.g., cardiopulmonary resuscitation [CPR], Standard First Aid, fall protection training)*;

D2.4 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the manufacturing industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.5 demonstrate an understanding of and apply the Essential Skills that are important for success in the manufacturing industry, as identified in the Ontario Skills Passport *(e.g., decision making, job task planning and organizing, problem solving)*;

D2.6 demonstrate an understanding of and apply the work habits that are important for success in the manufacturing industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, initiative, working independently)*;

D2.7 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in manufacturing technology *(e.g., Passport to Safety certificate, Ontario Skills Passport Work Plan, photographs of a project, technical drawings, reports, assignments)*, and explain why having a current portfolio is important for career development and advancement.

Manufacturing Technology, Grade 11

Workplace Preparation   TMJ3E

This hands-on, project-based course is designed for students planning to enter an
occupation or apprenticeship in manufacturing directly after graduation. Students
will work on a variety of manufacturing projects, developing knowledge and skills in
design, fabrication, and problem solving and using tools and equipment such as engine
lathes, milling machines, and welding machines. In addition, students may have the
opportunity to acquire industry-standard certification and training. Students will develop
an awareness of environmental and societal issues related to manufacturing and will
learn about secondary school pathways that lead to careers in the industry.

Prerequisite: None

A. MANUFACTURING TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of the primary manufacturing industries and the processes and technologies related to them;

A2. demonstrate an understanding of how a design process is used in the planning and development of a manufacturing project;

A3. describe and demonstrate the correct use of processes required for making material conversions;

A4. demonstrate an understanding of relevant mathematical and scientific concepts and apply technological literacy and communication skills in the study of manufacturing technology.

SPECIFIC EXPECTATIONS

A1. Primary Manufacturing Industries

By the end of this course, students will:

A1.1 describe how materials from primary manufacturing industries *(e.g., steel, plastics, lumber, paper)* are used in the manufacturing industry;

A1.2 identify and describe the key areas of operation in primary manufacturing industries *(e.g., design, planning, fabrication, inspection, worker safety)*;

A1.3 describe the influence that primary manufacturing industries have on secondary manufacturing industries *(e.g., in terms of availability of materials, cost, viability)*.

A2. Design Process

By the end of this course, students will:

A2.1 describe the steps of a design process used in the planning and development of a manufacturing project *(e.g., brainstorming, determining order of operations, developing flow charts, conducting a needs analysis, creating mock-ups)* (see pp. 22–23);

A2.2 describe how various forms of communication *(e.g., group discussion, brainstorming)*, graphic representation *(e.g., sketches, technical drawings, computer-aided design [CAD])*, and documentation *(e.g., research reports)* are used in the development of product ideas;

A2.3 identify and describe skills and attitudes needed to work as a cooperative member and/or leader of a group during the design process *(e.g., effective time management, goal setting, communication skills, respect for differences, ability to delegate tasks)*;

A2.4 explain why technological concepts *(e.g., aesthetics, control, environmental sustainability/ stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems)* are important considerations in the design process (see pp. 7–8).

A3. Material Conversion

By the end of this course, students will:

A3.1 describe and demonstrate the correct use of a variety of processes for joining materials *(e.g., shielded metal arc welding [SMAW], gas metal arc welding [GMAW], brazing, soldering, riveting, spot welding, crimping, bonding)*;

A3.2 describe and demonstrate the correct use of a variety of processes for cutting or separating materials *(e.g., using oxy-fuel torches, saws, mills, lathes, shears, plasma cutters)*;

A3.3 describe and demonstrate the correct use of a variety of processes for forming materials, using various tools and equipment *(e.g., hammers, box and pan brake, benders, rollers)*;

A3.4 demonstrate a working knowledge of basic metallurgy *(e.g., flame hardening, case hardening, tempering, annealing)*.

A4. Mathematics, Science, and Technological Literacy

By the end of this course, students will:

A4.1 demonstrate a working knowledge of various mathematical formulas *(e.g., related to trigonometry, geometry, force/power)* and applications *(e.g., tap drill sizing, calculating machine speeds and feeds, indexing)* that are commonly used in manufacturing;

A4.2 use mathematical calculations to solve manufacturing problems *(e.g., use algebraic equations; calculate perimeters, volumes, areas)*, using appropriate resources *(e.g., tables, charts)*;

A4.3 apply mathematical concepts *(e.g., linear systems, angle calculations, integers, orders of operations, decimals and fractions)* and skills in performing a variety of tasks required within the context of manufacturing design and production *(e.g., percent/decimal/fraction conversions, US customary / British imperial and metric unit conversions)*;

A4.4 identify the properties *(e.g., magnetic, physical, mechanical, thermal, electrical)* of natural and manufactured solid materials;

A4.5 describe how the physical properties of solid materials *(e.g., density, appearance, porosity, surface texture)* create advantages or disadvantages that affect their suitability for use in manufacturing;

A4.6 describe how the mechanical properties of solid materials *(e.g., hardness, ductility, elasticity, brittleness, compression, fatigue, shear, tensility)* create advantages or disadvantages that affect their suitability for use in manufacturing;

A4.7 demonstrate effective use of technological literacy and communication skills to interpret and communicate information related to manufacturing technology *(e.g., in technical manuals, reports, presentations)*.

B. MANUFACTURING TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. use technical design and production skills to interpret and prepare drawings and to develop process plans for a manufacturing project;

B2. demonstrate the ability to select appropriate materials for the manufacture of a product and prepare them properly for production;

B3. demonstrate a working knowledge of various metrology tools used to measure, lay out, and inspect a product;

B4. demonstrate a working knowledge of the purpose, characteristics, and safe use of various hand tools, machine tools, power tools, and equipment used in the manufacture of products.

SPECIFIC EXPECTATIONS

B1. Technical Drawings and Process Plans

By the end of this course, students will:

B1.1 demonstrate the ability to accurately interpret engineering drawings (*e.g., with respect to dimensions, welding symbols, weldments, notes and specifications, tolerances*) related to the production of a project;

B1.2 use appropriate sketching and/or drawing techniques to prepare working drawings (*e.g., sketches, scale drawings, perspectives, isometric and oblique views, assembly and detail drawings, pattern and layout development*) that convey ideas and processes and show materials and specifications;

B1.3 develop a process plan for the production of a product based on design criteria and specifications (*e.g., create a work plan, identify appropriate tools and equipment, produce a bill of material, develop a budget for the project, develop a flow chart of the project*).

B2. Selection and Preparation of Materials

By the end of this course, students will:

B2.1 select appropriate materials for the manufacture of a product based upon design criteria

(*e.g., criteria related to pattern and layout, cutting, squaring, drilling, machining, weld preparation and procedures*);

B2.2 use the proper procedures to prepare materials for production (*e.g., measuring, marking, grinding, cutting*).

B3. Metrology Tools

By the end of this course, students will:

B3.1 select and use a variety of measuring tools (*e.g., calipers, scales, micrometers, vernier calipers, dial indicators*) to measure projects according to specifications;

B3.2 demonstrate the use of precise layout techniques for projects using the proper equipment (*e.g., layout dye, scribe, marking punch, precision straight edge and square, vernier height gauge*);

B3.3 use inspection techniques (*e.g., inspection reports, destructive and non-destructive testing techniques, rubrics*) to evaluate projects and ensure quality;

B3.4 apply principles of dimensional metrology (*e.g., precision measurement, tolerancing for interchangeable manufacturing*) to manufacturing processes.

B4. Selection and Use of Tools and Equipment

By the end of this course, students will:

B4.1 demonstrate the correct selection and safe and proper use of hand and power tools and/or equipment *(e.g., lathe, mill, drill press, wrenches, tin snips, shears, rivet guns, foot and hand brakes, rollers, bar folds, punching and notching machines; equipment for shielded metal arc welding [SMAW], gas metal arc welding [GMAW], and gas tungsten arc welding [GTAW]; spot welder, plasma cutter, oxy-fuel torch, soldering gun)* when manufacturing a product;

B4.2 use the appropriate tools and/or equipment *(e.g., fasteners, rivets, tape, self-tapping screws)* for various assembly techniques *(e.g., welding, gluing/bonding)*;

B4.3 demonstrate a working knowledge of preventive maintenance *(e.g., cleaning, lubricating, sharpening)* and proper storage of tools and equipment commonly used in manufacturing.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of ways in which the manufacturing industry affects the environment;

C2. explain how the manufacturing industry affects various aspects of society.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 explain the importance of the proper storage, disposal, and recycling of obsolete and waste products in manufacturing;

C1.2 describe the benefits of using environmentally friendly products in the manufacturing process *(e.g., the benefits of water-based versus solvent-based chemicals)*;

C1.3 explain how various sources of power generation used in manufacturing *(e.g., coal, nuclear, solar, wind, hydrogen fuel cell, tidal, geothermal)* affect the environment;

C1.4 identify conservation strategies that the manufacturing industry could employ *(e.g., minimize water usage, convert to energy-efficient lighting, exploit transportation efficiencies, reduce paper usage by communicating electronically)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 explain how the manufacturing industry affects the economy of their community or region;

C2.2 explain how manufacturing affects people's daily lives;

C2.3 identify ways in which the manufacturing industry affects the culture and society of a community or region *(e.g., by creating employment opportunities; supporting social and cultural activities in the community; increasing industrial activity in the community/region, which some people may see as a threat to their way of life and/or the environment)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and compliance with health and safety legislation, standards, and practices as they relate to processes, materials, tools, and equipment used in manufacturing;

D2. demonstrate an understanding of career opportunities in the manufacturing industry and the education, training, and certification required for these careers.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify and explain the importance of the specific components of legislation and standards related to workplace safety in the manufacturing industry *(e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS])* and the specific responsibilities of the relevant oversight/regulatory organizations *(e.g., Workplace Safety and Insurance Board [WSIB], Industrial Accident Prevention Association [IAPA], Construction Safety Association of Ontario [CSAO])*;

D1.2 demonstrate good housekeeping practices in the work environment *(e.g., preventing and cleaning up spills and leaks, keeping areas clean and clear of obstructions, properly organizing tools and equipment)*;

D1.3 handle materials safely and appropriately in compliance with the information included in the Material Safety Data Sheets (MSDS) from the Workplace Hazardous Materials Information System (WHMIS);

D1.4 describe health and safety roles, responsibilities, and procedures in manufacturing *(e.g., concerning choice of equipment and materials, maintenance of equipment, storing of materials and equipment, inspection of facilities and equipment, in-service and training)*;

D1.5 demonstrate the safe use of tools and equipment in compliance with safety manuals, instructions, and institutional requirements;

D1.6 use protective clothing and equipment as required to ensure their own and others' safety in the work environment.

D2. Career Opportunities

By the end of this course, students will:

D2.1 identify employment opportunities available in the manufacturing industry locally, provincially, and nationally;

D2.2 identify the training and certification required *(e.g., by the Ministry of Training, Colleges and Universities – Workplace Training Branch)* to become a skilled tradesperson in the manufacturing industry;

D2.3 research and report on opportunities available locally to obtain certifications and/or training that it would be beneficial to have if they are pursuing a career in manufacturing *(e.g., cardio-pulmonary resuscitation [CPR], Standard First Aid, fall protection training, Canadian Welding Bureau certification)*;

D2.4 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the manufacturing industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.5 demonstrate an understanding of and apply the Essential Skills that are important for success in the manufacturing industry, as identified in the Ontario Skills Passport *(e.g., decision making, job task planning and organizing, problem solving)*;

D2.6 demonstrate an understanding of and apply the work habits that are important for success in the manufacturing industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, initiative, working independently)*;

D2.7 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in manufacturing technology *(e.g., Passport to Safety certificate, Ontario Skills Passport Work Plan, photographs of a project, technical drawings, reports, assignments)*, and explain why having a current portfolio is important for career development and advancement.

Manufacturing Engineering Technology, Grade 12

University/College Preparation   TMJ4M

This course enables students to further develop knowledge and skills related to design, process planning, control systems, project management, quality assurance, and business operations. Students will use a broad range of tools and equipment, enhance their skills in computer-aided design, and collaborate in managing a project. Students will critically analyse and solve complex problems involved in manufacturing products. Students will expand their awareness of environmental and societal issues and of career opportunities in the manufacturing industry.

Prerequisite: Manufacturing Engineering Technology, Grade 11, University/College Preparation

A. MANUFACTURING TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. describe the business operations associated with manufacturing and explain their role in product development;

A2. demonstrate an understanding of how to optimize individual or mass production systems by improving material flow, factory design, product layout, labour productivity, and quality control;

A3. demonstrate a working knowledge of various types of control systems used in the manufacturing process;

A4. apply relevant mathematical skills, scientific concepts, and technological literacy and communication skills in planning and implementing manufacturing processes.

SPECIFIC EXPECTATIONS

A1. Manufacturing Business Operations

By the end of this course, students will:

A1.1 explain the titles and roles shown on a standard manufacturing organization chart *(e.g., president, controller, purchasing / inventory control, human resources, marketing, engineering, sales, production)*;

A1.2 describe and explain activities associated with product development in manufacturing *(e.g., product research, product testing, product improvement)*;

A1.3 describe activities associated with marketing manufactured products *(e.g., market research, promotion, sales, distribution)*;

A1.4 identify factors to be considered in estimating the cost of manufacturing a product *(e.g., labour and materials, capital equipment, process costs, location/transportation)* and explain their importance.

A2. Process Planning

By the end of this course, students will:

A2.1 describe on the basis of research how to optimize production *(e.g., in terms of material flow, production layout, quality control, facility layout)* in various types of manufacturing facilities and systems;

A2.2 demonstrate an understanding of factors associated with labour costs in manufacturing a product *(e.g., labour-intensive versus capital-intensive production methods; use of unskilled, semi-skilled, and skilled labour)*;

A2.3 explain the technological systems approach to a manufacturing enterprise *(e.g., with respect to people, knowledge, materials, energy, finance, capital)*;

A2.4 plan in collaboration with others a detailed manufacturing process for production *(e.g., a process plan for part routing, a process plan that includes the use of robotics)*.

A3. Control Systems

By the end of this course, students will:

A3.1 explain the use of a variety of control systems *(e.g., electronic, pneumatic, hydraulic, mechanical)* to automate processes;

A3.2 design a manufacturing system *(e.g., robotic arm, drive system, lifting device)* using a variety of electronic, pneumatic, hydraulic, and mechanical control systems;

A3.3 select appropriate control systems for project production, and calculate power requirements *(e.g., load requirements, horsepower)*.

A4. Mathematics, Science, and Technological Literacy

By the end of this course, students will:

A4.1 apply advanced mathematical skills in performing a variety of tasks required within the context of manufacturing design and production *(e.g., calculate machine feeds and speeds, estimate costs, calculate ratios, calculate angles using trigonometry)*;

A4.2 apply scientific concepts to manufacturing-related processes *(e.g., properties of materials for selection purposes, work energy theorem for energy consumption measurements, non-destructive material testing to measure material quality and safety)*;

A4.3 use appropriate technical language and forms of communication related to the design, fabrication, and control of a product *(e.g., when preparing and explaining flow charts, operations and inspections charts, job descriptions, lists of tooling requirements, quality-control program materials; when describing certification requirements and specialized training; when making presentations; when completing a bill of material)*.

B. MANUFACTURING TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. apply a design process to plan and develop solutions, products, or services in response to challenges in manufacturing technology;

B2. demonstrate an understanding of the management of a manufacturing enterprise and the interrelationships among its major areas of activity such as marketing, cost control, quality assurance, production, and inventory control;

B3. demonstrate the safe and effective use of tools, equipment, and materials in the production of a product or the development of a production process;

B4. develop and use a quality assurance system to industry standards in the production of a project.

SPECIFIC EXPECTATIONS

B1. Design and Planning Process

By the end of this course, students will:

B1.1 use reverse engineering to explain existing products or processes in terms of function;

B1.2 demonstrate proficiency in using a design process to plan and develop solutions to manufacturing-related challenges;

B1.3 create a working drawing *(e.g., orthographic, isometric, pictorial)* with the use of computer-aided design that includes appropriate information *(e.g., geometric dimensioning and tolerancing, section views, symbols and abbreviations)* to assist in the development of solutions to manufacturing challenges;

B1.4 use a variety of communication techniques *(e.g., multimedia presentation, electronic presentation)* and supporting documentation *(e.g., prints, technical reports, statistical charting)* to present and explain a process design and plan;

B1.5 generate product specifications through the accurate interpretation of engineering drawings, sketches, and reports;

B1.6 select suitable materials for fabricating products based on the design specifications and the intended use of the products;

B1.7 use a design and planning process to solve a manufacturing challenge *(e.g., design and build a robot or control system prototype; design an auto-mated manufacturing system using process control charts; design solutions to create an ergonomically effective work environment)*.

B2. Project Management

By the end of this course, students will:

B2.1 demonstrate an understanding of management roles in the development of a product *(e.g., **planning:** setting goals to establish course of action; **organizing:** structuring the job into manageable tasks; **directing:** assigning tasks and supervising their completion; **controlling:** comparing results against the original plan)*;

B2.2 demonstrate an understanding of the management of a manufacturing enterprise *(e.g., set up and manage, in collaboration with others, a small-scale manufacturing enterprise; visit and document the activities of a local manufacturing enterprise)* and its major areas of activity *(e.g., research and development, production, marketing, and finance)*;

B2.3 create, in collaboration with others, a detailed process plan *(e.g., including robotic applications and other tools, machines, and equipment required)* to fabricate a final product;

B2.4 create, in collaboration with others, a product or process prototype/model *(e.g., rapid prototyping process)*;

B2.5 analyse the results of a production process, and modify operations, systems, and tooling as necessary.

B3. Tools, Equipment, and Manufacturing Processes

By the end of this course, students will:

B3.1 demonstrate the skills required to safely operate machine tools and equipment *(e.g., engine lathe, milling machine, drill press; equipment for gas tungsten arc welding [GTAW] and gas metal arc welding [GMAW])* in the assembly or fabrication of a product;

B3.2 use computers to operate and control systems *(e.g., for inventory, quality control, computer numerical control [CNC], programmable logic control [PLC])* in the assembly or fabrication of a product;

B3.3 assemble and use power control and automation systems to meet design and process planning criteria;

B3.4 demonstrate the safe and proper use of advanced cutting processes *(e.g., plasma, laser, water jet)*;

B3.5 demonstrate the appropriate use of advanced layout and set-up tools *(e.g., sine bar, gauge blocks, bevel protractor)*;

B3.6 use advanced measuring tools *(e.g., precision level, coordinate measuring machine, laser levels, optical comparators)* to calculate measurements in both metric and US customary/British imperial units;

B3.7 operate computer numerical control equipment *(e.g., CNC milling machine, CNC lathe, CNC plasma cutter)* in the assembly or fabrication of a product.

B4. Quality Assurance

By the end of this course, students will:

B4.1 identify organizations that develop standards regarding the conception and manufacture of consumer goods *(e.g., Canadian Standards Association [CSA], International Organization for Standardization [ISO])*;

B4.2 demonstrate a working knowledge of how quality assurance is used to maintain design specifications *(e.g., through quality inspection and testing procedures)*;

B4.3 manage and control quality using industry-standard techniques and processes *(e.g., statistical process control [SPC], total quality management [TQM])*;

B4.4 develop products and processes to meet customer specifications and quality control standards.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of ways in which the manufacturing industry affects the environment, and make informed decisions based on this understanding;

C2. assess the impact of the globalization of the manufacturing industry on society at the local, provincial, and national levels.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 identify potentially harmful consequences of manufacturing activities for the environment *(e.g., waste disposal, greenhouse gas emissions, water and energy consumption, the depletion of non-renewable resources)*, and formulate alternatives to reduce the severity of these consequences;

C1.2 assess and compare energy sources *(e.g., renewable – water, wind, solar, geothermal; non-renewable – coal, oil and gas, nuclear)* used in manufacturing, and identify ways of increasing environmentally friendly energy use;

C1.3 assess the carbon footprint of a manufactured product;

C1.4 explain the benefits of developing an environmentally friendly product *(e.g., a windmill that develops energy from wind power)* and assess its potential effectiveness.

C2. Technology and Society

By the end of this course, students will:

C2.1 explain how the globalization of the manufacturing industry affects the economy of the local community, the province of Ontario, and Canada as a whole;

C2.2 explain the importance of demographics, geography, and strategic plant location as factors to be considered in setting up a successful manufacturing facility, and describe possible short-term and/or long-term societal implications locally and beyond *(e.g., regional or provincial planning issues, effects on the indigenous population, ecosystem and/or habitat considerations)*;

C2.3 assess the effects of emerging manufacturing technology industries on culture and society from various perspectives *(e.g., safety, technical, financial, business)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and compliance with health and safety legislation, standards, and practices, including methods to address deficiencies, as they relate to the manufacturing industry;

D2. demonstrate an understanding of the importance of group dynamics and effective leadership in the manufacturing environment;

D3. demonstrate an understanding of the postsecondary programs associated with manufacturing, and establish a personalized career pathway.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 demonstrate an understanding of the specific components of legislation and standards related to workplace safety in the manufacturing industry *(e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS])* and the specific responsibilities of the relevant oversight/regulatory organizations *(e.g., Workplace Safety and Insurance Board [WSIB], Industrial Accident Prevention Association [IAPA]);*

D1.2 describe and assess ways to promote safe and productive work practices in the manufacturing workplace *(e.g., develop and use a safety checklist for work practices, tools, equipment, and operations; develop and conduct safety audits and inspections of the school manufacturing facility; design a plan to address health and safety deficiencies; develop an emergency action plan to implement in the event of a spill);*

D1.3 demonstrate good housekeeping practices in the work environment *(e.g., cleaning up spills and leaks, keeping areas clean and clear of obstructions, properly organizing tools and equipment);*

D1.4 handle materials safely and appropriately in compliance with the information included in the Material Safety Data Sheets (MSDS) from the Workplace Hazardous Materials Information System (WHMIS);

D1.5 use proper ventilation and/or filtration systems to control air quality *(e.g., to minimize the effects of welding fumes, plastic off-gassing, cutting-fluid misting, and heat treating);*

D1.6 demonstrate an understanding of the health hazards and injuries associated with workplace conditions *(e.g., repetitive motion and carpal tunnel syndrome, noise and hearing loss, radiation, pinch points);*

D1.7 explain how ergonomics can affect productivity, product quality, and employee needs and satisfaction, and identify ergonomic considerations related to workshop layout and set-up *(e.g., material handling, ease of movement, lighting, workstation design, organization of tools and equipment);*

D1.8 use and maintain protective clothing and equipment as required to ensure their own and others' safety in the work environment.

D2. Leadership

By the end of this course, students will:

D2.1 demonstrate an understanding of their personal strengths and areas for improvement in preparation for a career in the manufacturing industry;

D2.2 describe the role of management in the manufacturing industry in promoting equity, diversity, and non-discriminatory practices in the workplace;

D2.3 demonstrate the ability to work in various roles *(e.g., designer, scheduler, technician, supervisor)* as part of a manufacturing team from the concept stage to product completion;

D2.4 describe on the basis of research the requirements for a professional or managerial certification or designation *(e.g., Certified Engineering Technologist, Certified in Production and Inventory Management, Licensed Professional Engineer)* relevant to a career in manufacturing.

D3. Career Opportunities

By the end of this course, students will:

D3.1 demonstrate an understanding of the range of career opportunities within the manufacturing industry *(e.g., management, marketing, finance, purchasing, sales, production, quality control, engineering)*;

D3.2 describe postsecondary programs associated with the manufacturing industry and evaluate the appropriateness of these programs with respect to their personal career plans;

D3.3 demonstrate an understanding of and apply the Essential Skills that are important for success in the manufacturing industry, as identified in the Ontario Skills Passport *(e.g., decision making, job task planning and organizing, problem solving)*;

D3.4 demonstrate an understanding of and apply the work habits that are important for success in the manufacturing industry, as identified in the Ontario Skills Passport *(e.g., teamwork, working independently, organization)*;

D3.5 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in manufacturing technology *(e.g., Passport to Safety certificate, Ontario Skills Passport Work Plan and Transition Plan, photographs of a project, technical drawings, reports, assignments)*, and explain why having a current portfolio is important for career development and advancement.

Manufacturing Technology, Grade 12

College Preparation   TMJ4C

This course enables students to further develop knowledge and skills related to machining, welding, print reading, computer numerical control (CNC), robotics, and design. Students will develop proficiency in using mechanical, pneumatic, electronic, and computer control systems in a project-based learning environment and may have opportunities to obtain industry-standard training and certification. Students will expand their awareness of environmental and societal issues and career opportunities in the manufacturing industry.

Prerequisite: Manufacturing Technology, Grade 11, College Preparation

A. MANUFACTURING TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of how the design process is used as a problem-solving strategy to develop solutions to challenges or problems in manufacturing technology;

A2. demonstrate an understanding of the processes, tools, and equipment required for making material conversion;

A3. demonstrate a working knowledge of various control systems used in manufacturing processes;

A4. apply relevant mathematical skills, scientific concepts, and technological literacy and communication skills in the study of manufacturing technology.

SPECIFIC EXPECTATIONS

A1. Design Process

By the end of this course, students will:

A1.1 demonstrate proficiency in using a design process to solve manufacturing problems;

A1.2 explain, using specific examples, how the design process has been used in manufacturing to develop new products, or to improve products, to meet human needs or wants *(e.g., development of robotics for use in medical applications has improved surgical procedures and patient outcomes)*;

A1.3 explain why technological concepts *(e.g., aesthetics, control, environmental sustainability/ stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems)* are important considerations in the design process (see pp. 7–8);

A1.4 use technical drawings *(e.g., orthographic, pictorial, assembly drawings and sketches)* as part of the design process to develop solutions to challenges or problems in manufacturing technology;

A1.5 identify organizations that develop standards in the conception and manufacture of consumer goods *(e.g., Canadian Standards Association [CSA], International Organization for Standardization [ISO])*, and describe how these standards affect the design process.

A2. Material Conversion

By the end of this course, students will:

A2.1 describe the principles and practical applications of metallurgy *(e.g., hardening, tempering, annealing)*;

A2.2 demonstrate a working knowledge of correct tool geometry and terminology when adapting machine tools to allow for specific manufacturing operations *(e.g., prepare grinding tools with proper relief angles and cutting edges, use proper tool set-up for the application)*;

A2.3 describe in detail the function, purpose, and operation of advanced machine tools and technologies used in manufacturing *(e.g., computerized robot, laser applications, plasma cutting technologies, high-pressure water jet applications)*;

A2.4 explain material conversions such as the separation process *(e.g., converting a material's size and shape by removing excess material)*; the addition process *(e.g., combining materials to achieve enhanced qualities, as in alloys)*; the process of making changes to contours *(e.g., assembling materials by such means as gluing, mixing, fastening, bonding, welding)*; and the process of changing the properties *(e.g., thermal, chemical, mechanical, physical)* of solid materials.

A3. Control Systems

By the end of this course, students will:

A3.1 demonstrate a working knowledge of how to program computer numerical control (CNC) equipment using computer-aided manufacturing (CAM) software;

A3.2 demonstrate the correct use of a variety of power and control systems *(e.g., electronic, pneumatic, hydraulic, mechanical systems)*;

A3.3 demonstrate the proper use of various control software programs used in manufacturing processes *(e.g., programmable logic control [PLC], CNC, inventory control software)*.

A4. Mathematics, Science, and Technological Literacy

By the end of this course, students will:

A4.1 apply knowledge of scientific laws *(e.g., Newton's laws of motion, Boyle's law, Ohm's law, Pascal's law)* related to power transmission and mechanical mechanisms *(e.g., hydraulics, pneumatics, gears, pulleys, levers, couplings)* as appropriate during project planning and fabrication;

A4.2 apply mathematical and technological literacy skills to interpret product specifications *(e.g., volume, area, density/weight, material requirements, scrap factor)* accurately from engineering drawings;

A4.3 demonstrate effective use of research skills *(e.g., obtaining and evaluating information from technical documents and manufacturing resources)* and technological literacy and communication skills *(e.g., log note writing, record keeping, data recording, memo writing, schedule creation)* to plan and document work on a manufacturing project;

A4.4 correctly communicate the information needed to plan and prepare for the fabrication process *(e.g., order of operations, availability of tools, parts and equipment required, scheduling requirements, time requirements)*, applying relevant technological literacy skills;

A4.5 estimate the cost of a project, using the appropriate resources *(e.g., material costs, bill of material, estimated labour costs)* and relevant mathematical skills.

B. MANUFACTURING TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. demonstrate the ability to interpret and prepare technical drawings and develop process plans;

B2. select, prepare, and use appropriate materials when manufacturing a product to meet design specifications;

B3. apply quality control standards when using various advanced metrology tools to measure, lay out, and inspect the design and manufacture of products;

B4. use appropriate tools and equipment and a variety of manufacturing processes when planning and manufacturing a product to meet specifications.

SPECIFIC EXPECTATIONS

B1. Technical Drawings and Process Plans

By the end of this course, students will:

B1.1 demonstrate a working knowledge of the stages of the manufacturing process (*e.g., produce an order of operation chart, develop a bill of material for a project, undertake a cost analysis, develop a process plan*);

B1.2 interpret and create drawings or sketches (*e.g., orthographic projection, assembly, sectional, detail, pictorial*) that include specifications and information, such as symbols and legends, appropriate to the project;

B1.3 use appropriate resources and reference materials (*e.g., charts, tables, material- and product-related specifications, schematics*) when planning a project;

B1.4 use a variety of communication techniques (*e.g., multimedia presentation, electronic presentation*) and supporting documentation (*e.g., prints, technical reports, statistical charting*) to present and explain a process design and plan.

B2. Material Selection and Preparation

By the end of this course, students will:

B2.1 select on the basis of research the appropriate material(s) (*e.g., hot or cold rolled steel, drill rod, ferrous or non-ferrous metals, materials with high or low carbon content, appropriate welding electrode and/or gas*) for the manufacture of a product (*e.g., low-friction bearings and/or high-traction materials for a robot or robotic component*), based on design criteria;

B2.2 demonstrate a working knowledge of factors affecting material selection (*e.g., functionality, cost effectiveness, customer expectations, viability, availability*);

B2.3 use the proper procedures to prepare materials for production (*e.g., measuring, marking, cutting to rough length, grinding, cleaning, deburring*);

B2.4 test mechanical properties of materials using a tensile tester and hardness tester.

B3. Metrology Tools

By the end of this course, students will:

B3.1 demonstrate the correct use of common measurement instruments (*e.g., scales, gauge blocks, vernier calipers, inside/outside/depth micrometers, dial indicators, height gauges*) and advanced measuring tools (*e.g., precision level, coordinate measuring machine, laser levels, optical comparators, theodolites, master levels, optic levels, trammel points, opti-line*), using both metric and US customary/British imperial units;

B3.2 demonstrate the proper use of advanced layout and set-up tools (*e.g., sine bar, gauge blocks, bevel protractor*);

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B3.3 use the appropriate measuring tools to precisely measure objects to close tolerance and conduct an ongoing and final inspection process on the attributes of the product with reference to industry metrology standards *(e.g., using statistical process control [SPC] charts and reports).*

B4. Tools, Equipment, and Manufacturing Processes

By the end of this course, students will:

B4.1 demonstrate a working knowledge of the skills required to properly select and safely operate hand tools, machine tools, and equipment *(e.g., wrenches, electric drills, grinders, engine lathe, milling machine)* when manufacturing a product;

B4.2 maintain hand tools, machine tools, and equipment in good and safe working order;

B4.3 perform various manufacturing processes *(e.g., casting, moulding, coating, separating, assembling, cutting)* safely and correctly;

B4.4 demonstrate an understanding of advanced welding and cutting processes *(e.g., gas tungsten arc welding [GTAW], gas metal arc welding [GMAW], shielded metal arc welding [SMAW], plasma cutting, laser cutting, high-pressure water jet cutting);*

B4.5 use various joining processes and/or assembly techniques *(e.g., SMAW, GMAW, GTAW, oxy-acetylene welding, brazing, soldering, tinning, bonding, use of appropriate fasteners)* to complete projects.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of the importance of using sustainable and environmentally friendly manufacturing practices;

C2. explain the importance of manufacturing to the economy and society.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 demonstrate the proper selection and disposal of oils, fluids, and materials used in manufacturing;

C1.2 explain how the three Rs (reduce, reuse, recycle) can minimize the effect the manufacturing industry has on the environment;

C1.3 explain the advantages and disadvantages of using various renewable and sustainable energy sources *(e.g., solar, hydrogen fuel cell, wind, geothermal, tidal)* in manufacturing;

C1.4 assess the benefits of using environmentally friendly products and processes in manufacturing *(e.g., long-term cost savings, creation of positive company image by establishing "green" credentials);*

C1.5 follow environmentally responsible practices during the design and manufacture of a product *(e.g., minimize waste, consider using renewable or recyclable materials, design and manufacture products that last or can be repaired as opposed to throwaway products, use processes that have minimal impact on workers and the local environment).*

C2. Technology and Society

By the end of this course, students will:

C2.1 explain how the local and/or provincial manufacturing industry has changed over time and describe the effects of these changes on the local and/or provincial economy and society;

C2.2 explain how global economic shifts are reflected in the local and/or provincial manufacturing industry;

C2.3 explain how apprenticeships, salaries, standards of living, and the role of skilled trades in society are interrelated;

C2.4 assess the effects of emerging manufacturing technology industries on culture and society from various perspectives *(e.g., safety, technical, financial, business).*

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and compliance with health and safety legislation, standards, and practices, including methods to address deficiencies, as they relate to the manufacturing industry;

D2. demonstrate an understanding of career opportunities in the manufacturing industry and the training and certification required for these careers.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 demonstrate an understanding of the specific components of legislation and standards related to workplace safety in the manufacturing industry *(e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS])* and the specific responsibilities of the relevant oversight/regulatory organizations *(e.g., Workplace Safety and Insurance Board [WSIB], Industrial Accident Prevention Association [IAPA], Construction Safety Association of Ontario [CSAO])*;

D1.2 describe and assess ways to promote safe and productive work practices in the manufacturing workplace *(e.g., develop and use a safety checklist for work practices, tools, equipment, and operations; develop and conduct safety audits and inspections of the school manufacturing facility; design a plan to address health and safety deficiencies)*;

D1.3 demonstrate good housekeeping practices in the work environment *(e.g., cleaning up spills and leaks, keeping areas clean and clear of obstructions, properly organizing tools and equipment)*;

D1.4 handle materials safely and appropriately in compliance with the information included in the Material Safety Data Sheets (MSDS) from the Workplace Hazardous Materials Information System (WHMIS);

D1.5 use proper ventilation and/or filtration systems to control air quality *(e.g., to minimize the effects of welding fumes, plastic off-gassing, cutting-fluid misting, and heat treating)*;

D1.6 explain how ergonomics can affect productivity, product quality, and employee needs and satisfaction, and identify ergonomic considerations related to workshop layout and set-up *(e.g., material handling, ease of movement, lighting, workstation design, tool and equipment organization, speed and efficiency)*;

D1.7 use and maintain protective clothing and equipment as required to ensure their own and others' safety in the work environment.

D2. Career Opportunities

By the end of this course, students will:

D2.1 assess their personal aptitude for career opportunities in the manufacturing industry;

D2.2 assess postsecondary programs associated with manufacturing and develop a personal pathway leading to a specific career;

D2.3 research and report on opportunities available locally to obtain certifications and/or training that it would be beneficial to have if they are pursuing a career in manufacturing *(e.g., cardiopulmonary resuscitation [CPR], Standard First Aid, fall protection training)*;

D2.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the manufacturing industry, as identified in the Ontario Skills Passport *(e.g., decision making, job task planning and organizing, problem solving)*;

D2.5 demonstrate an understanding of and apply the work habits that are important for success in the manufacturing industry, as identified in the Ontario Skills Passport *(e.g., teamwork, working independently, organization)*;

D2.6 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in manufacturing technology *(e.g., Passport to Safety certificate, Ontario Skills Passport Work Plan and Transition Plan, photographs of a project, technical drawings, reports, assignments)*, and explain why having a current portfolio is important for career development and advancement.

Manufacturing Technology, Grade 12

Workplace Preparation   **TMJ4E**

This project-driven, hands-on course builds on students' experiences in manufacturing technology. Students will further develop knowledge and skills related to the use of engine lathes, milling machines, welding machines, and other tools and equipment as they design and fabricate solutions to a variety of technological challenges in manufacturing. Students may also have opportunities to acquire industry-standard training and certification. Students will expand their awareness of environmental and societal issues and of career opportunities in the manufacturing industry.

Prerequisite: Manufacturing Technology, Grade 11, Workplace Preparation

A. MANUFACTURING TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of the secondary manufacturing industries and the processes and technologies related to them;

A2. demonstrate a working knowledge of how a design process is used to develop and fabricate projects in response to challenges or problems in manufacturing technology;

A3. demonstrate a working knowledge of the processes required for making material conversions;

A4. apply relevant mathematical and scientific concepts and technological literacy and communication skills in the study of manufacturing technology.

SPECIFIC EXPECTATIONS

A1. Secondary Manufacturing Industries

By the end of this course, students will:

A1.1 describe how materials from secondary manufacturing industries can be used to produce finished products *(e.g., types of structural steel, hollow structural steel, wide flange steel, angle iron)*;

A1.2 identify and describe the key areas of operation in secondary manufacturing industries *(e.g., product design, production planning, product fabrication, quality control, worker safety)*;

A1.3 identify and describe production methods *(e.g., custom, assembly line, flexible, mass production)* used in the manufacturing of various products;

A1.4 identify organizations that develop standards regarding the conception and manufacture of consumer goods *(e.g., Canadian Standards Association [CSA], International Organization for Standardization [ISO])*;

A1.5 describe in detail the function, purpose, and operation of advanced machine tools and equipment *(e.g., computer numerical control [CNC] machines, water jet cutting machine, laser equipment, hydro-forming machine)* used in secondary manufacturing.

A2. Design Process

By the end of this course, students will:

A2.1 demonstrate how a design process can be used in all phases of project development from conception to finished product *(e.g., in analysing the situation, defining the problem or need, synthesizing ideas, planning procedures, generating solutions, evaluating results for continuous product improvement)*;

A2.2 describe how the design process is used to improve manufacturing methods *(e.g., with respect to material flow, equipment layout, tool organization and maintenance, cost savings, efficiency)*;

A2.3 demonstrate appropriate use of various forms of communication *(e.g., brainstorming, discussion, presentations)*, graphic representation *(e.g., sketches, technical drawings, computer-aided design [CAD])*, and documentation *(e.g., research reports)* in the development of a project;

A2.4 demonstrate skills and attitudes needed to work as a cooperative member and/or leader of a group during the design process *(e.g., effective time management, goal setting, conflict resolution, communication skills, respect for differences, evaluation of strengths and weaknesses, ability to delegate tasks)*;

A2.5 demonstrate a working knowledge of ways in which technological concepts *(e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems)* are important considerations in the design process (see pp. 7–8).

A3. Material Conversion

By the end of this course, students will:

A3.1 apply appropriately a variety of processes used to join materials *(e.g., gas tungsten arc welding [GTAW], gas metal arc welding [GMAW], shielded metal arc welding [SMAW], bonding, fastening)*;

A3.2 demonstrate a working knowledge of the processes used to cut or separate materials *(e.g., using a CNC machine, oxy-acetylene cutting torch, lathe, mill)*;

A3.3 demonstrate correct processes for forming materials, using various tools and equipment *(e.g., brake press; English wheel; forging, casting, and moulding tools and equipment)*;

A3.4 demonstrate correct processes for converting the structure of a material using a variety of metallurgical processes *(e.g., heat treating, annealing, shrinking, tempering/work hardening)*.

A4. Mathematics, Science, and Technological Literacy

By the end of this course, students will:

A4.1 demonstrate appropriate use of various mathematical formulas *(e.g., related to trigonometry, sine rule, taper calculation, bend allowances)* and applications *(e.g., tap drill sizing, calculating machine speed and feed rate, indexing)* that are commonly used in manufacturing;

A4.2 use appropriate mathematical solutions to solve manufacturing problems *(e.g., use algebraic equations; calculate perimeters, volumes, areas)*, consulting appropriate resources *(e.g., tables, charts)*;

A4.3 apply mathematical concepts and scientific principles *(e.g., **concept:** torque; **principle:** Bernoulli's principle)* related to power transmission and mechanical mechanisms *(e.g., hydraulics, pneumatics, gears, pulleys, levers, couplings)*;

A4.4 demonstrate a working knowledge of physical and mechanical properties of materials *(e.g., **physical:** appearance, density, surface texture; **mechanical:** hardness, malleability, ductility, elasticity)* that affect the suitability of materials for use in manufacturing;

A4.5 use appropriate manufacturing terminology to communicate information related to the fabrication of a project;

A4.6 demonstrate effective use of research skills *(e.g., obtaining and evaluating information from technical documents and manufacturing resources)* and technological literacy and communication skills *(e.g., log note writing, record keeping, data recording, memo writing, schedule creation)* to plan and document work on a manufacturing project.

B. MANUFACTURING TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. use technical drawing skills and a design process to create engineering drawings that provide solutions to project development challenges;

B2. select and use the proper materials when manufacturing a product to meet specifications;

B3. apply advanced metrology skills to measure, lay out, and inspect a product;

B4. demonstrate the safe and proper use of tools and equipment when producing various projects to meet specifications.

SPECIFIC EXPECTATIONS

B1. Technical Drawings and Process Plans

By the end of this course, students will:

B1.1 demonstrate a working knowledge of how the design process is used to develop an effective solution to a manufacturing problem or challenge (*e.g., describe and analyse a situation and define the specific problem or need; research criteria, constraints, and availability of materials; generate a number of possible solutions, using techniques such as brainstorming; select the optimal solution; test and evaluate the product; repeat steps as necessary*);

B1.2 demonstrate the ability to accurately interpret detailed engineering drawings and assembly drawings (*e.g., with respect to welding symbols, legends, dimensions, tolerances*) related to the development of a project;

B1.3 interpret and/or create sketches or drawings (both manual and computer-aided) that include the measurements and symbols required to complete a project;

B1.4 select appropriate resources and reference materials (*e.g., charts, tables, material- and product-related specifications, schematics*) when planning a project.

B2. Selection and Use of Materials

By the end of this course, students will:

B2.1 select, organize, and prepare appropriate materials for the manufacture of a product based on material properties (*e.g., physical, mechanical, thermal*) and design criteria (*e.g., hot or cold rolled steel, size and grade of steel drill rod, carbon content, ferrous or non-ferrous metals, type of welding electrode and/or gas*);

B2.2 select appropriate materials for a project based on identified criteria such as functionality, cost effectiveness, customer expectations, viability, availability, and sustainability;

B2.3 demonstrate a working knowledge of metallurgy (*e.g., hardening, tempering, annealing, quenching*) and the mechanical properties of materials (*e.g., tensile strength, hardness, ductility, malleability, elasticity*).

B3. Metrology Skills

By the end of this course, students will:

B3.1 use the proper measuring tools (*e.g., vernier caliper, inside/outside/depth micrometers, dial indicators, height gauges, gauge blocks, sine bars*) to precisely measure objects to a specified tolerance, and calibrate measuring tools using acceptable national standards;

B3.2 apply advanced layout processes when preparing a component or project for production;

B3.3 apply an inspection technique (*e.g., statistical process control*) to evaluate projects and ensure quality.

B4. Selection and Use of Tools and Equipment

By the end of this course, students will:

B4.1 select and use the correct machine tools, hand tools, and power tools *(e.g., wrenches, electric drills, grinders, rollers, cutters, box and pan brake, shears, engine lathe, milling machine)* when manufacturing a project;

B4.2 use the appropriate tools and/or equipment for various assembly techniques *(e.g., using fasteners, using adhesives, riveting, soldering, welding, brazing, silver soldering, tinning, using jigs, using fixtures)*;

B4.3 adapt machine tools safely to allow for a variety of uses *(e.g., grinding, drilling, cutting)*;

B4.4 develop and apply a preventive maintenance schedule for the manufacturing shop *(e.g., detailing proper storage techniques, tool and equipment maintenance procedures)*.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of the importance of using sustainable and environmentally friendly manufacturing practices;

C2. explain how the manufacturing industry affects society locally, provincially, and/or nationally.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 demonstrate an understanding and application of the three Rs in a manufacturing facility *(e.g., reduction of waste through efficient selection and conversion of materials, reuse of materials when possible, effective collection and recycling of materials and/or fluids)*;

C1.2 demonstrate the use of proper techniques for the disposal of obsolete and/or waste products;

C1.3 describe the advantages and disadvantages of using various renewable and sustainable energy sources *(e.g., solar, hydrogen fuel cell, wind, geothermal, tidal)* and alternative fuels *(e.g., biodiesel, ethanol)* in manufacturing;

C1.4 follow environmentally responsible practices during the design and manufacture of a product *(e.g., minimize waste, consider using renewable or recyclable materials, design and manufacture products that last or can be repaired as opposed to throwaway products, use processes that have minimal impact on workers and the local environment)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 describe the effect the manufacturing industry has on the local community and explain the advantages of manufacturing locally;

C2.2 explain how the globalization of manufacturing industries affects Canadian society locally, provincially, and/or nationally *(e.g., explain the effects of trade agreements, worker health and safety standards or the lack of such standards, environmental standards or the lack of such standards)*;

C2.3 demonstrate an understanding of the role and value of skilled trades in Canadian society *(e.g., in terms of having a skilled and competitive workforce, employment opportunities, services provided)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and compliance with health and safety legislation, standards, and practices, including methods to address deficiencies, as they relate to the manufacturing industry;

D2. demonstrate an understanding of the postsecondary pathways leading to careers in manufacturing and the training and certification required for these careers.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 demonstrate an understanding of the specific components of legislation and standards related to workplace safety in the manufacturing industry *(e.g., Occupational Health and Safety Act [OHSA], Workplace Hazardous Materials Information System [WHMIS])* and the specific responsibilities of the relevant oversight/regulatory organizations *(e.g., Workplace Safety and Insurance Board [WSIB], Industrial Accident Prevention Association [IAPA], Construction Safety Association of Ontario [CSAO])*;

D1.2 identify and list key ways to promote safe and productive work practices in the manufacturing workplace *(e.g., develop and use a safety checklist for work practices, tools, equipment, and operations; develop and conduct safety audits and inspections of the school manufacturing facility)*;

D1.3 use proper ventilation and/or filtration systems to control air quality *(e.g., to minimize the effects of welding fumes, plastic off-gassing, cutting-fluid misting, and heat treating)*;

D1.4 handle materials safely and appropriately in compliance with the information included in the Material Safety Data Sheets (MSDS) from the Workplace Hazardous Materials Information System (WHMIS);

D1.5 describe how ergonomics affects productivity, product quality, cost savings/efficiencies, and employee needs and satisfaction, and identify ergonomic considerations related to workshop layout and set-up *(e.g., material handling, ease of movement, lighting, workstation design)*;

D1.6 use and maintain protective clothing and equipment as required to ensure their own and others' safety in the work environment.

D2. Career Opportunities

By the end of this course, students will:

D2.1 evaluate the career opportunities available through apprenticeships, other training programs, and direct entry into the workforce, and assess their personal aptitude for such opportunities;

D2.2 research and report on opportunities available locally to obtain certifications and/or training that it would be beneficial to have if they are pursuing a career in manufacturing *(e.g., cardiopulmonary resuscitation [CPR], Standard First Aid, propane safety training, equipment lockout training, confined space training, Canadian Welding Bureau certification, fall protection training)*;

D2.3 demonstrate an understanding of and apply the Essential Skills that are important for success in the manufacturing industry, as identified in the Ontario Skills Passport *(e.g., decision making, job task planning and organizing, problem solving)*;

D2.4 demonstrate an understanding of and apply the work habits that are important for success in the manufacturing industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, initiative, working independently)*;

D2.5 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in manufacturing technology *(e.g., Passport to Safety certificate, Ontario Skills Passport Work Plan and Transition Plan, photographs of a project, technical drawings, reports, assignments)*, and explain why having a current portfolio is important for career development and advancement.

TECHNOLOGICAL DESIGN

Technological design courses provide students with a variety of learning experiences that focus on the practical application of the principles of engineering, architecture, and design. These activity-based courses emphasize problem solving to meet design challenges in a wide range of areas, which may include apparel and textile design, architectural design, interior design, mechanical and industrial design, and robotics and control systems.

Students learn to apply knowledge of research, historical trends, design, materials, fabrication methods, and testing criteria to develop innovative and environmentally sustainable products, processes, and/or services. The technologies and processes used to create design solutions may include both traditional and computer-based drafting methods, scale models, working prototypes, animations and simulations, displays, portfolios, and presentations.

The list of approved emphasis areas for technological design can be found at www.edu.gov.on.ca/eng/curriculum/secondary/teched.html.

- Courses in technological education are suitable for use in cooperative education programs and in connection with other forms of experiential learning as well as in programs such as the Specialist High Skills Major (SHSM). For more information, see pages 43–44 of this document.
- For policy guidelines pertaining to multiple-credit courses and emphasis courses, see pages 17–18 of this document.

Technological Design, Grade 11

University/College Preparation   TDJ3M

This course examines how technological design is influenced by human, environmental, financial, and material requirements and resources. Students will research, design, build, and assess solutions that meet specific human needs, using working drawings and other communication methods to present their design ideas. They will develop an awareness of environmental, societal, and cultural issues related to technological design, and will explore career opportunities in the field, as well as the college and/or university program requirements for them.

Prerequisite: None

A. TECHNOLOGICAL DESIGN FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of factors and relationships that affect technological design and the design process;

A2. describe appropriate strategies, techniques, and tools for researching, organizing, planning, and managing design projects and related activities, with an emphasis on financial, human, and material resources;

A3. demonstrate an understanding of drafting standards, conventions, and guidelines for various types of drawings used to represent designs;

A4. demonstrate an understanding of a variety of tools, materials, equipment, and processes used to build, test, and evaluate models and prototypes;

A5. use appropriate terminology and communication methods to document, report, and present progress and results.

SPECIFIC EXPECTATIONS

A1. Design Process

By the end of this course, students will:

A1.1 describe ways in which society, the environment, and the economy inspire and/or affect technological design *(e.g., need for barrier-free access or alternative-energy vehicles)*, with reference to key technological concepts *(e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems)* (see pp. 7–8);

A1.2 identify the steps in the design process *(e.g., define the problem or challenge, taking into account relevant contextual or background information; gather information about criteria, constraints, and available materials; generate possible solutions, using techniques such as brainstorming; choose the best solution; develop and produce a model or prototype; test the model or prototype; incorporate improvements or redesign and retest; report results)* (see pp. 22–23), and demonstrate an understanding of the relationships among the steps *(e.g., prototype testing can show that more idea development is needed)*;

A1.3 evaluate various technical products *(e.g., portable music player, backpack, cell phone)* in terms of key technological concepts;

A1.4 demonstrate an understanding of the relationship between technological design and art, science, technology, the environment, and commerce;

A1.5 establish design criteria based on client interviews, consultations, and research *(e.g., determine client's needs, budget, and lifestyle; research technical requirements, material limitations, function of space, and existing infrastructure)*;

A1.6 describe the role that the five senses (touch, taste, smell, sight, and hearing) play in technological design *(e.g., shapes, colours, and layouts that make controls easy to read and operate; lighting and colour schemes that set a mood and/or make a room, garden, or building attractive)*.

A2. Research and Project Management

By the end of this course, students will:

A2.1 identify and locate sources of technical and design information *(e.g., Machinery's Handbook, Sweet's building product catalogues, magazines, the Internet, interviews)*, using a variety of techniques and tools;

A2.2 research and describe strategies for the planning, organization, and management of human, material, and financial resources for a design project *(e.g., strategies for delegating tasks, selecting materials, estimating costs)*.

A3. Representing Design Ideas Graphically

By the end of this course, students will:

A3.1 identify and describe different methods for representing design ideas graphically *(e.g., mind maps, sketches, design layouts, computer-aided drafting)*, with reference to principles and elements of graphic design *(e.g., **principles**: gradation, emphasis, pattern, balance; **elements**: space, shape, size, value)*;

A3.2 demonstrate an understanding of drawing types *(e.g., pictorial drawings, floor plans, elevations, sections, detail drawings, rendered drawings)* and of drafting standards and conventions *(e.g., **standards**: Canadian Standards Association [CSA]; **conventions**: symbols, abbreviations, shading, dimension labels, geometries)*, with an emphasis on working drawings;

A3.3 accurately interpret technical drawings and specifications.

A4. Making and Testing Models and Prototypes

By the end of this course, students will:

A4.1 identify and describe different types of models *(e.g., conceptual, physical, virtual, theoretical)* and prototypes *(e.g., proof-of-principle, functional, form study)*;

A4.2 compare a variety of modelling tools *(e.g., shaping tools; fabric shears; computer-aided design [CAD] software; computer numerically controlled [CNC] mill, lathe, or router)* and materials *(e.g., matt board, starch, linen)* in terms of suitability, time, budget, and availability;

A4.3 identify various criteria for assessing models and prototypes *(e.g., adherence to specifications, material cost, assembly time, material availability, waste produced, cultural appropriateness)* and the methods and equipment used to perform the assessment *(e.g., **methods**: measuring dimensions, wind tunnel testing; **equipment**: colour wheel, decibel meter, weigh scale)*.

A5. Reporting and Presenting

By the end of this course, students will:

A5.1 use technical terminology correctly when documenting, reporting on, and presenting design projects *(e.g., vernier caliper, orthographic, fillet, bisect, construction lines, shears)*;

A5.2 compare reporting styles and formats *(e.g., **styles**: American Psychological Association [APA], Modern Language Association [MLA]; **formats**: portfolio, journal, logbook, technical report, reflection paper)*;

A5.3 describe and use the appropriate tools *(e.g., word processor, multimedia hardware, display board, image board [lifestyle, mood, styling, usage])* and formats *(e.g., oral or multimedia presentation, technical report)* for documenting, reporting, and presenting design ideas and results;

A5.4 demonstrate an understanding of the components of a technical report *(e.g., design brief, criteria and constraints, idea development, planning, design analysis, evaluation, technical drawings, design summary)*.

B. TECHNOLOGICAL DESIGN SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. use appropriate strategies and tools to research and manage design projects and related activities;

B2. apply appropriate methods for generating and graphically representing design ideas and solutions;

B3. create and test models and/or prototypes, using a variety of techniques, tools, and materials;

B4. use a variety of formats and tools to create and present reports summarizing the design process and to reflect on decisions made during the process.

SPECIFIC EXPECTATIONS

B1. Researching and Managing Projects

By the end of this course, students will:

B1.1 use various research methods and strategies to gather, organize, and interpret design information from appropriate resources *(e.g., building codes, Machinery's Handbook, interviews, union contracts)*;

B1.2 use project management strategies and tools *(e.g., project evaluation and review technique [PERT], time sheets, critical path analysis)* to plan and organize finances, human resources, and materials for projects and related activities.

B2. Developing and Representing Design Ideas

By the end of this course, students will:

B2.1 use freehand sketches to help brainstorm initial design concepts for a project;

B2.2 apply mathematical and scientific concepts and skills as required in the course of designing projects;

B2.3 differentiate between artistic and technical criteria for a design;

B2.4 produce hand-drafted and/or computer-based working drawings and other technical drawings of design solutions, using industry-recognized drafting standards and conventions;

B2.5 apply principles and elements of graphic design to enhance design ideas in concept drawings and/or presentation-quality drawings.

B3. Making and Testing Models and Prototypes

By the end of this course, students will:

B3.1 create design models *(e.g., conceptual, physical, virtual, theoretical)* and/or functional prototypes *(e.g., proof-of-principle, functional)* using appropriate tools *(e.g., fabric shears, computer-aided design [CAD] software, computer numerical control [CNC] machine tools)*, equipment *(e.g., computer, cut-out pattern)*, procedures *(e.g., tracing, forming, assembly)*, and materials *(e.g., matt board, starch, linen, neoprene)*;

B3.2 use appropriate metric and imperial measuring tools, scales *(e.g., metric: 1:10, 1 cm:1 m or 1:100, 1:500; imperial: $^1/_2$":1' or 1:24)*, and proportion techniques when creating and assessing models and/or prototypes;

B3.3 assess products and/or processes on the basis of student-developed criteria *(e.g., adherence to specifications, effectiveness, cost, durability, appearance, estimated labour and material costs, cultural sensitivies, effect on the environment)*.

B4. Reporting and Presenting

By the end of this course, students will:

B4.1 create and present reports summarizing design choices and the steps taken in the design process, using a variety of formats and tools *(e.g., word processor, presentation software, interactive white board, web pages)*;

B4.2 report and reflect on decisions made throughout the design process, using a variety of oral and/or written formats.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of environmentally responsible design practices, and apply them in the technological design process and related activities;

C2. describe the relationship between society and technological development.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 demonstrate an understanding of environmental issues that affect the design of products and/or processes *(e.g., gasoline consumption, pollution, greenhouse gases, habitat loss, extinction of species, depletion of natural resources)*;

C1.2 describe, advocate, and apply best practices for conserving energy and other resources when designing a product or process *(e.g., reuse or recycle lumber and other materials; use materials with recycled content; use wood glue instead of hot glue; use renewable energy sources, high-efficiency motors and appliances, and passive heating and cooling of buildings)*;

C1.3 describe ways to reduce the waste produced by the manufacture and use of products *(e.g., cutting patterns that minimize leftover materials, use of materials that are easily recycled, energy-management controls in electronic equipment)*, and apply such practices when developing and building prototypes.

C2. Technology and Society

By the end of this course, students will:

C2.1 research and compare technological eras *(e.g., agricultural, industrial, information)*, and describe ways in which societal needs influenced these eras;

C2.2 research and describe cases where technological design has improved the quality of living *(e.g., fireproofing, prosthetic limbs, air purifiers, catalytic converters)*;

C2.3 demonstrate an understanding of ways in which history, trends, culture, and geography have inspired technological design.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. describe and apply health, safety, and environmental practices related to technological design;

D2. identify career opportunities in fields related to technological design, and describe the training and education required for these careers.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 describe the importance of health and safety laws, regulations, and standards that apply to technological design (*e.g., regulations and standards from the Occupational Health and Safety Act, Canadian Standards Association [CSA], Ontario Building Code, and Workplace Hazardous Materials Information System [WHMIS]*);

D1.2 adhere to appropriate personal and environmental health and safety standards and procedures with respect to processes, materials, tools, equipment, and facilities throughout the design process and when performing related activities (*e.g., use protective equipment; set tool and equipment guards properly; ensure adequate ventilation and ergonomic seating and other workplace arrangements; follow safe operating procedures; keep work areas clean and organized; store materials and dispose of wastes properly*);

D1.3 use protective clothing, gear, and equipment appropriately (*e.g., dust mask, safety glasses*).

D2. Career Opportunities

By the end of this course, students will:

D2.1 identify a variety of career opportunities related to technological design (*e.g., architect, architectural technologist, draftsperson, interior designer*);

D2.2 describe the educational and training pathways (i.e., selection of secondary and post-secondary courses, programs, and learning experiences) and entry requirements (*e.g., portfolio, internship*) for careers related to technological design;

D2.3 research and report on professional associations and unions for technical designers (*e.g., Professional Engineers of Ontario [PEO], Ontario Association of Chartered Industrial Designers of Ontario [OACID], Ontario Association of Certified Engineering Technicians and Technologists [OACETT], Ontario Association of Architects [OAA], Association of Registered Interior Designers of Ontario [ARIDO]*), and describe how these organizations affect jobs in technological design (*e.g., working conditions, job security*);

D2.4 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the technological design industry (*e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations*);

D2.5 demonstrate an understanding of and apply the Essential Skills that are important for success in the technological design industry, as identified in the Ontario Skills Passport (*e.g., reading text, writing, document use, measurement and calculation*);

D2.6 demonstrate an understanding of and apply the work habits that are important for success in the technological design industry, as identified in the Ontario Skills Passport (*e.g., working safely, teamwork, reliability, initiative, customer service, entrepreneurship*);

D2.7 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in technological design (*e.g., work logs, skills checklist, sketches, drawings, photographs of models and prototypes*), and explain why having a current portfolio is important for career development and advancement.

Technological Design and the Environment, Grade 11

Open   TDJ3O

This course enables students to apply a systematic process for researching, designing, building, and assessing solutions to address specific human and environmental challenges. Through their work on various projects, students will explore broad themes that may include aspects of industrial design, mechanical design, architectural design, control system design, and/or apparel design. Students will develop an awareness of environmental and societal issues related to technological design, and will learn about secondary and postsecondary pathways leading to careers in the field.

Prerequisite: None

A. TECHNOLOGICAL DESIGN FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. describe the design process, and identify ways in which technological design can address an environmental need or challenge;

A2. describe and apply strategies, techniques, and tools for researching, planning, and organizing projects to meet a specific environmental or other need;

A3. demonstrate an understanding of drafting standards, conventions, and guidelines for representing design ideas graphically;

A4. compare various kinds of models and prototypes and identify criteria, equipment, and methods for assessing them;

A5. demonstrate an understanding of the technical and environmental terminology and the communication methods and formats used in the design process.

SPECIFIC EXPECTATIONS

A1. Design Process

By the end of this course, students will:

A1.1 describe the purpose of design for a given project (*e.g., cleaner energy, reduced carbon foot-print, less manufacturing waste*) in terms of key technological concepts (*e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems*) (see pp. 7–8);

A1.2 describe the need for technological designs that take environmental factors into account (*e.g., fuel-efficient vehicles, non-toxic paints and pesticides, renewable energy sources, sustainable production of materials*);

A1.3 identify and describe the steps in the design process (*e.g., define the problem or challenge, taking into account relevant contextual or background information; gather information about criteria, constraints, and available materials; generate possible solutions, using techniques such as brainstorming; choose the best solution; develop and produce a model or prototype; test the model or prototype; incorporate improvements or redesign and retest; report results*) (see pp. 22–23);

A1.4 describe the relationship between various steps of the design process (*e.g., testing a model*

or prototype, and then incorporating improvements or redesigning and retesting if necessary*).

A2. Research, Planning, and Organization

By the end of this course, students will

A2.1 identify and apply strategies for gathering information from various sources (*e.g., books, Ministry of the Environment website, interview with a naturalist*) for a design project that meets an environmental need;

A2.2 describe strategies and tools for planning and organizing a design project;

A2.3 plan ways to apply the principles of sustainability and minimize environmental harm throughout the design process for a project (*e.g., plan to use recycled materials, limit the use of energy-consuming equipment*).

A3. Representing Design Ideas Graphically

By the end of this course, students will:

A3.1 compare different methods for representing design ideas graphically (*e.g., mind maps, sketches, computer-aided drawings*);

A3.2 identify and describe various types of technical drawings *(e.g., 2D and 3D drawings, floor plans, elevations, sections, detail and rendered drawings)* and the drafting standards and conventions used in them *(e.g., symbols, abbreviations, line types)*.

A4. Making and Testing Models and Prototypes

By the end of this course, students will:

A4.1 compare various kinds of models *(e.g., conceptual, physical, virtual, theoretical)* and prototypes *(e.g., proof-of-principle, functional, form study)*, taking into account the tools and materials required to produce them *(e.g., **tools:** cut out patterns, animation; **materials:** paper, wax, clay, wood, metals, composites, plastics, cardboard, starch, textiles)*, as well as the amount of energy used and the wastes produced;

A4.2 identify criteria for assessing designs *(e.g., adherence to specifications, effectiveness, cost, durability, appearance)*;

A4.3 identify criteria for assessing the environmental friendliness of a design and of the processes required to produce it *(e.g., by-products, waste, energy consumption, reuse and/or recycling of materials, biodegradability)*;

A4.4 identify equipment *(e.g., decibel meter, height gauge, weighing scale, colour wheel)* and methods *(e.g., measuring dimensions, compression testing, wind tunnel testing)* used for assessing prototypes.

A5. Reporting and Presenting

By the end of this course, students will:

A5.1 demonstrate an understanding of technical and environmental terminology used in the design process *(e.g., drafting versus drawing, scale versus ruler, greenhouse gases, parts per billion, fossil fuel)*;

A5.2 describe how various report formats can be used to record design ideas and document the progress of a design project *(e.g., portfolio, journal, logbook, sketchbook)*;

A5.3 choose the most effective method to communicate progress and results for a given project from a variety of presentation tools and strategies *(e.g., LCD projector, display board, oral or written presentation)*.

B. TECHNOLOGICAL DESIGN SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. use appropriate tools and strategies to research, plan, and organize design projects that have environmentally sound designs and production processes;

B2. apply appropriate methods for generating and graphically representing design ideas and solutions;

B3. construct models and prototypes using a variety of techniques, tools, and materials, and assess these models and prototypes in terms of the design criteria;

B4. report on the progress, environmental rationale, and results of the design process, using appropriate formats and styles.

SPECIFIC EXPECTATIONS

B1. Research, Planning, and Organization

By the end of this course, students will:

B1.1 gather and summarize relevant information for developing various designs (*e.g., Canadian Standards Association [CSA] publications, Ontario Building Code, environmental criteria)*;

B1.2 investigate and describe economic and environmental factors that should be considered during the design process;

B1.3 select and apply effective planning and organizational tools and strategies (*e.g., sequence chart, time sheet, swatch book, checklists, file management)* to develop environmentally sound design projects.

B2. Developing and Representing Design Ideas

By the end of this course, students will:

B2.1 create freehand sketches showing key features (*e.g., shapes, texture, protrusions, unusual features, relationships among parts)* to help develop initial concepts for a design project;

B2.2 apply mathematical and scientific concepts and skills as required in the course of designing various products and/or processes;

B2.3 produce hand-drafted and/or computer-based technical drawings (*e.g., elevation, plan, schematic, exploded view)* of design solutions, using common drafting standards and conventions (*e.g., format, line type and weight, symbols)*.

B3. Making and Testing Models and Prototypes

By the end of this course, students will:

B3.1 use appropriate tools, equipment, and materials to create design models and prototypes (*e.g., **tools:** rotary tool, bandsaw, fabric shears, computer-aided design [CAD] software; **equipment:** computer, sewing machine; **materials:** paper, wax, clay, wood, metals, composites, plastics, cardboard, starch, textiles)*;

B3.2 use appropriate metric and imperial measuring tools, scales (*e.g., **metric:** 1:10, 1 cm:1 m or 1:100, 1:500; **imperial:** $1/2$":1' or 1:24)*, and proportion techniques when creating a model or prototype;

B3.3 test models and/or prototypes, and evaluate designs using student-generated criteria (*e.g., by-products, waste, energy consumption, biodegradability, reliability, durability)*.

B4. Reporting and Presenting

By the end of this course, students will:

B4.1 present a report summarizing the design choices, progress, and results of the design project, with an emphasis on how the design deals with environmental concerns, using a variety of tools *(e.g., presentation software, inter-active white board, web pages, word-processing software)*;

B4.2 report and reflect on the decisions they made and their experiences throughout the design process, using appropriate written and/or oral formats.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of environmentally responsible design practices and strategies, and apply them in the technological design process and related activities;

C2. describe how society influences technological innovation and how technology affects society.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 identify environmental issues that affect technological design *(e.g., pollution, greenhouse gases, resource use, ozone depletion)*;

C1.2 describe and apply best practices for conserving energy and other resources when designing a product or process *(e.g., reuse or recycle materials, use wood glue instead of hot glue, use energy management systems for computers)*;

C1.3 research and report on organizations and/or community partners that foster environmentally friendly design practices *(e.g., Ontario Centre for Environmental Technology Advancement, other Canadian environmental technology advancement centres)*;

C1.4 describe innovative technological designs *(e.g., alternative energy sources, more efficient automobiles, ways of reducing manufacturing waste)* that were developed in response to changes in the environment *(e.g., global warming, pollution, rainforest destruction)*;

C1.5 compare the environmental impact of various products that are used for the same purpose *(e.g., plastic bags versus paper bags or reusable cloth bags, paper cups versus polystyrene foam cups)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 research and report on how society influences technology *(e.g., higher energy costs spur development of more efficient vehicles, increasing population density leads to the construction of taller buildings, environmental awareness leads to development of alternative energy sources)*;

C2.2 describe how technological design has benefited society *(e.g., prosthetic limbs, on-demand water heaters, catalytic converters, nanotechnology, wireless communication, air purifiers)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. describe and apply appropriate health, safety, and environmental practices and standards throughout the design process;

D2. identify careers related to technological design, and describe the training and education required for these careers.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 investigate and describe health, safety, and environmental laws, regulations, standards, and agencies that can affect technological design *(e.g., Ontario Environmental Bill of Rights, Clean Water Act, Canadian Standards Association [CSA] standards, Workplace Hazardous Materials Information System [WHMIS]);*

D1.2 demonstrate an understanding of and follow personal and environmental health and safety procedures with respect to processes, materials, tools, equipment, and facilities throughout the design process and when performing related activities *(e.g., use protective equipment; set tool and equipment guards properly; ensure adequate ventilation and ergonomic seating and other work-place arrangements; follow safe operating procedures; keep work areas clean and organized; store materials and dispose of wastes properly);*

D1.3 use protective clothing, gear, and equipment appropriately *(e.g., dust mask, safety glasses).*

D2. Career Opportunities

By the end of this course, students will:

D2.1 identify a variety of career opportunities related to technological design *(e.g., civil engineer, architect, mechanical engineering technician, environmental technologist, landscape designer, fashion designer, interior designer);*

D2.2 identify education and training requirements *(e.g., degree, diploma, certificate, apprenticeship)* for specific careers related to technological design;

D2.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the technological design industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations);*

D2.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the technological design industry, as identified in the Ontario Skills Passport *(e.g., reading text, writing, document use, measurement and calculation);*

D2.5 demonstrate an understanding of and apply the work habits that are important for success in the technological design industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability, initiative, customer service, entrepreneurship);*

D2.6 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in technological design *(e.g., work logs, skills checklist, sketches, drawings, photographs of models and prototypes, virtual models),* and explain why having a current portfolio is important for career development and advancement.

Technological Design, Grade 12

University/College Preparation

TDJ4M

This course introduces students to the fundamentals of design advocacy and marketing, while building on their design skills and their knowledge of professional design practices. Students will apply a systematic design process to research, design, build, and assess solutions that meet specific human needs, using illustrations, presentation drawings, and other communication methods to present their designs. Students will enhance their problem-solving and communication skills, and will explore career opportunities and the postsecondary education and training requirements for them.

Prerequisite: Technological Design, Grade 11, University/College Preparation

A. TECHNOLOGICAL DESIGN FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of criteria, relationships, and other factors that affect technological design and the design process;

A2. describe strategies, techniques, and tools for researching, organizing, planning, and managing design projects and related activities, with an emphasis on advocacy, diplomacy, and marketing;

A3. demonstrate an understanding of drafting standards, drawing types, conventions, and guidelines used when representing design ideas graphically;

A4. demonstrate an understanding of various types of models and prototypes, and describe the tools, materials, equipment, and processes for building, testing, and evaluating them;

A5. use appropriate technical language and communications methods to document, report, present, and market design ideas and results.

SPECIFIC EXPECTATIONS

A1. Design Process

By the end of this course, students will:

A1.1 describe environmental and societal needs *(e.g., barrier-free access, alternative-energy vehicles)* that influence product designs, with reference to key technological concepts *(e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems)* (see pp. 7–8);

A1.2 describe how the results of each step in the design process affects the next step in the process *(e.g., prototype testing can show that more idea development is needed)* (see pp. 22–23);

A1.3 identify and establish design criteria *(e.g., style, aesthetics, functionality, cost, market)* for a variety of clients and environments *(e.g., business, health care, entertainment, religious)*, based on interviews with clients, technical requirements, and research.

A2. Research and Project Management

By the end of this course, students will:

A2.1 identify and locate sources of technical data and related information for a design project *(e.g., trade literature, catalogues, applicable codes,* *municipal and provincial laws and regulations, workshops, seminars)*, using a variety of techniques and tools;

A2.2 describe strategies for organizing, planning, and managing the human, material, and financial resources for a design project and related activities, with an emphasis on advocacy of design ideas and rationales, diplomacy in dealing with clients and suppliers, and marketing of design solutions *(e.g., establishing roles for project team members, advocating for environmentally sound materials, promoting and marketing innovative designs)*.

A3. Representing Design Ideas Graphically

By the end of this course, students will:

A3.1 compare different methods for representing design ideas graphically *(e.g., annotated sketches, expressive drawings, design layouts, computer-aided drafting)*, and identify examples of best practices;

A3.2 demonstrate an understanding of drawing types *(e.g., 2D and 3D drawings, floor plans, elevations, sections, detail drawings, rendered drawings)*, and of drafting standards, conventions, and guidelines *(e.g., dimensions, symbols, abbreviations, geometries, tolerances; standards and*

guidelines provided by the American National Standards Institute [ANSI] and the American Society of Mechanical Engineers [ASME]);

A3.3 accurately interpret technical references, drawings, test data, and specifications.

A4. Making and Testing Models and Prototypes

By the end of this course, students will:

A4.1 compare a variety of types of models and prototypes *(e.g., **models**: conceptual, physical, virtual, theoretical; **prototypes**: proof-of-principle, functional, form study)* and modelling tools, equipment, materials, and procedures *(e.g., **tools**: foam-injection moulding machine; rapid prototyper; computer-aided mill, lathe, or sewing machine; **materials**: metals, thermoplastics, neoprene)* in terms of suitability, time, budget, and availability;

A4.2 identify and compare tools and equipment used to assess models and/or modelling processes *(e.g., three-dimensional coordinate measuring machine, decibel meter, height gauge, compression tester)*;

A4.3 describe criteria for assessing models *(e.g., functionality, size, weight, durability, mechanical and physical features)* and modelling processes *(e.g., material costs, assembly time, waste produced)* for a given project.

A5. Reporting and Presenting

By the end of this course, students will:

A5.1 use technical terminology correctly when documenting design projects, reporting and presenting results, and marketing designs *(e.g., vernier caliper, scale versus ruler, shears versus scissors, geometries versus shapes)*;

A5.2 describe and compare formats and tools for documenting, reporting, presenting, and marketing design ideas and results throughout the design process *(e.g., **formats**: oral or written presentation, multimedia production, theatrical presentation, role play; **tools**: multimedia software, display board, image board [lifestyle, mood, styling, usage])*;

A5.3 describe and compare various reporting styles and formats *(e.g., **styles**: American Psychological Association [APA], Modern Language Association [MLA]; **formats**: portfolio, technical report, critique)*.

B. TECHNOLOGICAL DESIGN SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. use appropriate resources, methods, and tools to research and manage design projects and related activities;

B2. apply appropriate methods for generating and graphically representing complex design ideas and solutions;

B3. create, test, and analyse models and/or prototypes, using a variety of techniques, tools, and materials;

B4. use a variety of formats and tools to create and present reports summarizing and evaluating the design process, to analyse decisions made during the process, and to advocate the final design.

SPECIFIC EXPECTATIONS

B1. Researching and Managing Projects

By the end of this course, students will:

B1.1 research and analyse pertinent information from appropriate resources *(e.g., building codes, Machinery's Handbook, interviews, union contracts)*;

B1.2 use project management methods and tools *(e.g., checklists, templates, software, surveys, focus groups, questionnaires)* to support, plan, and manage components *(e.g., financial, labour, material)* of design projects and related activities, with a view to incorporating effective advocacy and marketing principles in the process.

B2. Developing and Representing Design Ideas

By the end of this course, students will:

B2.1 use freehand sketches to help brainstorm initial design concepts for a project;

B2.2 apply mathematical and scientific concepts and skills as required in the course of designing various products and/or processes;

B2.3 create presentation-quality drawings to represent design ideas, using a variety of principles and elements of graphic design;

B2.4 produce a variety of types of hand-drafted and/or computer-based technical drawings *(e.g., elevation, schematic, exploded view)* of design solutions, using industry-recognized drafting standards and conventions *(e.g., geometric tolerancing, schedules)*, with an emphasis on illustrations and presentation-quality drawings.

B3. Making and Testing Models and Prototypes

By the end of this course, students will:

B3.1 select and use appropriate tools, equipment, and materials when creating design models and/or functional prototypes;

B3.2 use appropriate metric and imperial measuring tools, scales *(e.g., metric: 1:10, 1 cm:1 m or 1:100, 1:500; imperial: $^1/_2$":1' or 1:24)*, and proportion techniques when creating and assessing models and/or prototypes;

B3.3 analyse products and/or processes on the basis of student-justified criteria *(e.g., aesthetics, ergonomics, performance, functionality, cost, environmental stewardship)*, with an emphasis on marketability;

B3.4 finish a model or prototype to professional standards *(e.g., surface finish, detailing, painting)*.

B4. Reporting and Presenting

By the end of this course, students will:

B4.1 create and present reports summarizing and evaluating all aspects of the design process, using a variety of tools *(e.g., multimedia equipment, simulation overlays, magnetic illustration board)*, with an emphasis on promotional and marketing strategies;

B4.2 report on and analyse decisions made throughout the design process, and advocate for the final design, using a variety of oral and/or written formats.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of environmentally responsible design practices, and apply them in the technological design process and related activities;

C2. analyse the relationship between society and technological development.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 identify and analyse environmental effects of a particular industry or technological system *(e.g., mass transit system, strip mining, sewer system)*, and recommend practices that are economically and environmentally sustainable;

C1.2 describe ways in which environmental issues influence the design of products and/or processes;

C1.3 describe, advocate for, and apply best practices for conserving energy and other resources when designing a product or process *(e.g., reuse or recycle lumber and other materials; use materials with recycled content; use wood glue instead of hot glue; use renewable energy sources, high-efficiency motors and appliances, and passive heating and cooling of buildings)*;

C1.4 describe ways to reduce the waste produced by the manufacture and use of products *(e.g., cutting patterns that minimize leftover materials, use of materials that are easily recycled, energy-management controls in electronic equipment)*, and apply such practices when developing and building prototypes.

C2. Technology and Society

By the end of this course, students will:

C2.1 independently research and report on political, economic, cultural, and/or environmental issues that affected technological innovations in the past *(e.g., traffic congestion spurred development of compact vehicles, increasing population density led to the construction of taller buildings)*;

C2.2 describe examples of how culture, economics, and politics could influence the future design of products and/or processes *(e.g., environmental awareness and rising costs for fossil fuels could increase the development and use of alternative energy sources)*;

C2.3 describe how technological change affects society *(e.g., developments in telecommunications, health care, and robotics)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. describe and apply personal and environmental health and safety standards and practices related to technological design;

D2. compare a variety of careers related to technological design, as well as the training and educational requirements for them, and maintain a portfolio of their work as evidence of their qualifications for future education and employment.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify and describe the bodies and agencies that regulate, promote, and test the safety of technological products and/or processes *(e.g., Health Canada, Canadian Society of Safety Engineering [CSSE], Canadian Standards Association [CSA])*, and explain how they work to prevent accidents and enforce standards *(e.g., certification, product recalls)*;

D1.2 adhere to and promote personal and environmental health and safety standards and procedures with respect to processes, materials, tools, equipment, and facilities throughout the design process and when performing related activities *(e.g., use protective equipment; set tool and equipment guards properly; ensure adequate ventilation and ergonomic workplace arrangements; follow safe operating procedures and maintain tools and equipment in good working condition; keep work areas clean and organized; store materials and dispose of wastes properly; report safety violations)*;

D1.3 use protective clothing, gear, and equipment appropriately *(e.g., dust mask, safety glasses)*;

D1.4 describe the rights and responsibilities of employees under the Occupational Health and Safety Act *(e.g., right to know, right to refuse, right to participate)*.

D2. Career Opportunities

By the end of this course, students will:

D2.1 identify and compare a variety of career opportunities related to technological design *(e.g., architect versus architectural technologist, draftsperson versus designer)*;

D2.2 compare postsecondary education *(e.g., university, college, skills training centres)* and entry requirements *(e.g., portfolio, internship)* for a variety of technological design careers, and describe lifelong professional development opportunities associated with them *(e.g., continuing education, workshops, seminars)*;

D2.3 demonstrate an understanding of and apply the Essential Skills that are important for success in the technological design industry, as identified in the Ontario Skills Passport *(e.g., reading text, writing, document use, computer use, oral communication, numeracy, thinking skills)*;

D2.4 demonstrate an understanding of and apply the work habits that are important for success in the technological design industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability, organization, working independently, initiative, self-advocacy)*;

D2.5 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in technological design *(e.g., work logs, skills checklist, sketches, drawings, photographs of models and prototypes)*, and explain why having a current portfolio is important for career development and advancement.

Technological Design in the Twenty-first Century, Grade 12

Open TDJ4O

This course focuses on the relationship between society and technological development. Students will use appropriate tools, techniques, and strategies to research, design, build, and assess prototypes for products and/or processes that respond to society's changing needs. Students will describe how social factors, including culture, media, politics, religion, and environmental concerns, influence technological design. Students will also learn about professional practices in the field, and will research postsecondary pathways leading to careers related to technological design.

Prerequisite: None

A. TECHNOLOGICAL DESIGN FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. describe the design process and ways in which technological design is influenced by societal needs;

A2. describe strategies, techniques, and tools for researching, planning, and managing projects to meet a specific societal or other need;

A3. demonstrate an understanding of various methods for graphically representing design ideas and solutions;

A4. demonstrate an understanding of various kinds of models and prototypes, and describe methods and equipment for making and assessing them;

A5. demonstrate an understanding of the terminology and communication methods and formats used in the design process.

SPECIFIC EXPECTATIONS

A1. Design Process

By the end of this course, students will:

A1.1 describe the purpose of design for a given project *(e.g., technological convergence, cost-efficient products, smaller living spaces)* with reference to key technological concepts *(e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems)* (see pp. 7–8);

A1.2 describe ways in which societal needs, including environmental and economic factors, influence technological design *(e.g., need for products that are smaller, lighter, faster, safer, and/or easier to use)*;

A1.3 describe the steps in the design process *(e.g., define the problem or challenge, taking into account relevant contextual or background information; gather information about criteria, constraints, and available materials; generate possible solutions, using techniques such as brainstorming; choose the best solution; develop and produce a model or prototype; test the model or prototype; incorporate improvements or redesign and retest; report results)* (see pp. 22–23);

A1.4 describe the relationship between various steps of the design process *(e.g., testing a model or prototype, and then incorporating improvements or redesigning and retesting if necessary)*.

A2. Research, Planning, and Organization

By the end of this course, students will:

A2.1 investigate and describe a variety of strategies, techniques, and tools for gathering pertinent information from appropriate sources *(e.g., magazines covering social issues, Ministry of Culture website, interview with a cultural leader)*;

A2.2 describe strategies for the planning and management of human, material, and financial resources related to a design project *(e.g., delegating tasks, selecting materials, estimating costs)*.

A3. Representing Design Ideas Graphically

By the end of this course, students will:

A3.1 describe different methods for representing design ideas graphically *(e.g., mind maps, sketches, design layouts, computer-aided drafting)* with reference to principles and elements of graphic design *(e.g., **principles:** contrast, proportion, movement, emphasis, pattern, balance; **elements:** line, colour, space, shape, size, value)*;

A3.2 demonstrate an understanding of drawing types *(e.g., pictorial and rendered drawings, floor plans, elevations, sections, detail drawings)* and of drafting methods *(e.g., hand drawn, computer-aided)*, standards *(e.g., Canadian Standards*

Association [CSA]), and conventions *(e.g., for dimensions, symbols, and abbreviations)*;

A3.3 accurately interpret technical drawings and specifications.

A4. Making and Testing Models and Prototypes

By the end of this course, students will:

A4.1 compare various kinds of models *(e.g., conceptual, physical, virtual, theoretical)* and prototypes *(e.g., proof-of-principle, functional, form study)*, taking into account the tools, equipment, procedures, and materials required to produce them *(e.g., **tools:** fabric shears, computer-aided design [CAD] software, computer numerical control [CNC] machine tools; **equipment:** computer, cut-out pattern; **procedures:** tracing, forming; **materials:** matt board, starch, linen, neoprene)*;

A4.2 describe ways to assess models on the basis of various design criteria *(e.g., societal needs, functionality, size, weight, durability, aesthetics, use of recyclable materials, cultural appropriateness)*;

A4.3 identify and describe equipment *(e.g., decibel meter, height gauge, compression tester)* for assessing prototypes.

A5. Reporting and Presenting

By the end of this course, students will:

A5.1 demonstrate an understanding of industry-standard terminology *(e.g., scale versus ruler, artistic drawing versus technical drawing)*;

A5.2 investigate and compare a variety of presentation methods *(e.g., oral report, multimedia presentation, use of presentation software, use of overhead versus LCD projector, multimedia versus slides)* based on relevant criteria *(e.g., cost, ease of use, effectiveness for delivering intended message)*;

A5.3 describe the characteristics of various styles and formats for tracking and reporting the progress of a project *(e.g., journals, portfolios, blogs)*.

B. TECHNOLOGICAL DESIGN SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. use appropriate strategies and tools to research, plan, organize, and manage design projects;

B2. develop designs and represent them graphically, using industry standards for illustrations and technical drawings;

B3. construct models and prototypes, using a variety of techniques, tools, and materials, and assess these models and prototypes in terms of the design criteria;

B4. report on design choices, the societal influences that helped determine those choices, project evaluations, and reflections on their experiences throughout the design process, using appropriate formats and styles.

SPECIFIC EXPECTATIONS

B1. Research, Planning, and Organization

By the end of this course, students will:

B1.1 gather and analyse relevant background information and design ideas from various sources (*e.g., Canadian Standards Association [CSA] publications, Ontario Building Code, Machinery's Handbook*);

B1.2 investigate and report on societal factors that influence technological design (*e.g., news media, politics, religion, environment, gender, cultural and ethnic diversity*);

B1.3 use appropriate strategies and tools (*e.g., sequence chart, time sheet, checklist, file management*) to help plan, organize, and manage design projects;

B1.4 research and identify relevant design criteria and constraints relating to societal influences (*e.g., cultural considerations when designing restaurants, use of environmentally friendly materials, gender-specific designs*).

B2. Developing and Representing Design Ideas

By the end of this course, students will:

B2.1 create and present freehand sketches to illustrate initial design concepts, applying a variety of elements and principles of graphic design;

B2.2 apply mathematical and scientific concepts and skills as required in the course of designing various products and/or processes;

B2.3 produce technical drawings (*e.g., orthographic projection, isometric projection*) and/or presentation-quality drawings (*e.g., perspective renderings, 3D computer imaging*) of design solutions, using common drafting standards (*e.g., line types, dimensioning, title block*).

B3. Making and Testing Models and Prototypes

By the end of this course, students will:

B3.1 use appropriate tools, equipment, and materials to create design models and prototypes (*e.g., **tools:** rotary tool, bandsaw, fabric shears, computer-aided design [CAD] software; **equipment:** computer, sewing machine; **materials:** paper, wax, clay, wood, metals, composites, plastics, cardboard, starch, textiles*);

B3.2 use appropriate metric and imperial measuring tools, scales (*e.g., **metric:** 1:10, 1 cm:1 m or 1:100, 1:500; **imperial:** $1/2$":1' or 1:24*), and proportion techniques when creating a model or prototype;

B3.3 analyse products and/or processes in terms of established criteria and constraints (*e.g., appearance, durability, ease of use, cost, budgetary constraints, societal concerns and preferences*).

B4. Reporting and Presenting

By the end of this course, students will:

B4.1 create and present reports summarizing design choices and results of evaluations of projects, using a variety of appropriate formats *(e.g., multimedia or oral presentation, technical report)*, with an emphasis on how the design was affected by societal influences;

B4.2 report and reflect on their experiences throughout the design process, assessing individual skills development and the productivity and dynamics of the team, using appropriate written and/or oral formats.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of environmentally responsible design practices and strategies, and apply them in the technological design process and related activities;

C2. research and describe the relationship between society and technological development.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 demonstrate an understanding of environmental issues that affect product design *(e.g., finite non-renewable resources, pollution, wastes, greenhouse gases, climate change, ozone depletion, life cycle of products)*;

C1.2 describe, promote, and apply design practices that conserve energy and other resources *(e.g., reuse or recycle lumber and other materials, use materials with recycled content, use wood glue instead of hot glue, use energy-management software for computers and other electronic equipment, use renewable energy, use high-efficiency motors and appliances)*;

C1.3 demonstrate an understanding of technological, political, and social strategies for managing the relationship between society and the environment *(e.g., technological developments to improve energy efficiency and/or reduce emissions, lobbying governments for regulations and/or funding to improve the environment, education about environmental issues)*;

C1.4 explain how good design can reduce the wastes produced by the manufacture and use of products.

C2. Technology and Society

By the end of this course, students will:

C2.1 research and report on the history of technological eras *(e.g., agricultural, industrial, and information eras)* and developments *(e.g., invention of seed drill, mechanization of production, wireless communication)*;

C2.2 describe how society influences technology *(e.g., higher energy costs spur development of more efficient vehicles, increasing population density leads to the construction of taller buildings, environmental awareness leads to development of alternative energy sources)*;

C2.3 describe how technological change affects society *(e.g., health care developments increase lifespan, robotics replace human resources)*;

C2.4 describe intellectual property rights related to the design of products *(e.g., copyright, trademark, patent)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. describe and apply appropriate health, safety, and environmental practices and standards throughout the design process;

D2. investigate and describe a variety of careers related to technological design, and describe the training and education required for them.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 describe health and safety laws, regulations, standards, and agencies that relate to technological design (*e.g., Ontario Building Code, Canadian Standards Association [CSA], Ministry of Labour*);

D1.2 adhere to personal and environmental health and safety standards and procedures with respect to processes, materials, tools, equipment, and facilities throughout the design process and related activities (*e.g., use protective equipment; set tool and equipment guards properly; ensure adequate ventilation and ergonomic seating and other workplace arrangements; follow safe operating procedures; keep work areas clean and organized; store materials and dispose of wastes properly*);

D1.3 use protective clothing, gear, and equipment appropriately (*e.g., dust mask, safety glasses*);

D1.4 describe the rights and responsibilities of employees under the Occupational Health and Safety Act (*e.g., right to know, right to refuse, right to participate*).

D2. Career Opportunities

By the end of this course, students will:

D2.1 describe a variety of career and business opportunities related to technological design (*e.g., engineering, architecture, industrial design, control systems, apparel/textile design*);

D2.2 identify and compare the educational and training requirements (*e.g., degree, diploma, certificate, apprenticeship*) for specific careers in technological design and related trades and services;

D2.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the technological design industry (*e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations*);

D2.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the technological design industry, as identified in the Ontario Skills Passport (*e.g., reading text, writing, document use, computer use, oral communication, numeracy, thinking skills*);

D2.5 demonstrate an understanding of and apply the work habits that are important for success in the technological design industry, as identified in the Ontario Skills Passport (*e.g., working safely, teamwork, reliability, organization, working independently, initiative, self-advocacy*);

D2.5 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in technological design (*e.g., work logs, skills checklist, sketches, drawings, photographs of models and prototypes, virtual models*), and explain why having a current portfolio is important for career development and advancement.

TRANSPORTATION TECHNOLOGY

Transportation affects our lives in a multitude of ways. Transportation systems move raw materials to manufacturers and finished products to consumers locally, nationally, and globally. Individuals use transportation systems every day for business, work, and pleasure.

Transportation technology courses provide students with opportunities to understand transportation systems from the perspective of either the consumer or the service provider. The range of courses enables students to study both vehicle ownership and vehicle maintenance, and to develop skills and prepare for careers in the servicing and repair of vehicles, aircraft, and/or watercraft. In addition, students will develop the Essential Skills and work habits that are important for success in the transportation industry.

The list of approved emphasis areas for transportation technology can be found at www.edu.gov.on.ca/eng/curriculum/secondary/teched.html.

- Courses in technological education are suitable for use in cooperative education programs and in connection with other forms of experiential learning as well as in programs such as the Specialist High Skills Major (SHSM). For more information, see pages 43–44 of this document.
- For policy guidelines pertaining to multiple-credit courses and emphasis courses, see pages 17–18 of this document.

Transportation Technology, Grade 11

College Preparation TTJ3C

This course enables students to develop technical knowledge and skills as they study, test, service, and repair engine, electrical, suspension, brake, and steering systems on vehicles, aircraft, and/or watercraft. Students will develop communication and teamwork skills through practical tasks, using a variety of tools and equipment. Students will develop an awareness of environmental and societal issues related to transportation, and will learn about apprenticeship and college programs leading to careers in the transportation industry.

Prerequisite: None

A. TRANSPORTATION TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of the fundamental principles of engines and their service, repair, and maintenance;

A2. demonstrate an understanding of basic electrical and electronic circuits and their components;

A3. identify the function and explain the operation of the major systems and components of vehicles, aircraft, and/or watercraft;

A4. demonstrate accurate and appropriate use of technical and mathematical knowledge and skills in the study of transportation technology.

SPECIFIC EXPECTATIONS

A1. Understanding Engines

By the end of this course, students will:

A1.1 explain terminology describing internal combustion engines *(e.g., top dead centre, overhead camshaft)*, cylinder configurations *(e.g., V6, in-line)*, and types of measurement *(e.g., bore, stroke, cylinder displacement)* in terms of engine operation;

A1.2 describe the design and construction of various components of an internal combustion engine *(e.g., camshafts, pistons, crankshafts, rotors, valves, turbines)*;

A1.3 describe the service procedures required to rebuild, repair, and maintain engines *(e.g., use of correct torque procedures, use of plastigauge to check bearing clearance, use of feeler gauges and micrometers to check clearances, use of chemical compounds [sealants, thread-locking compounds])*;

A1.4 explain the principles on which the operation of fuel, lubrication, and coolant systems is based *(e.g., fuel: volatility; lubrication: viscosity; coolant: heat transfer)*;

A1.5 explain how engine timing *(e.g., ignition timing, valve timing, mechanical fuel injection timing)* is used to achieve optimal engine performance;

A1.6 describe the parts, operation, and care of a variety of precision measuring tools *(e.g., micrometer, vernier caliper, torque wrench, dial indicator, bore gauge)* and demonstrate proper use of these tools;

A1.7 describe common procedures for inspecting engine components for wear and faults *(e.g., check cylinder for taper, check cylinder head for warpage)* and demonstrate accurate use of these procedures.

A2. Understanding Electrical and Electronic Circuits and Components

By the end of this course, students will:

A2.1 describe the fundamental concepts and laws related to the flow of electricity *(e.g., flow of electrons, magnetic fields, Ohm's law, Kirchhoff's laws)* that underlie the electrical components and systems found in vehicles, craft, and powered equipment;

A2.2 define electrical units of measure *(e.g., volts, amps, ohms)* and demonstrate the ability to read wiring schematics *(e.g., wire size and colour, symbols)*;

A2.3 define the fundamentals of electronic circuits and components *(e.g., on-board computers, diodes, transistors, light-emitting diodes [LEDs])*;

A2.4 explain the consequences of open, short, ground, and unintentional ground circuits *(e.g., electrical surges, voltage drop, voltage spike)*;

A2.5 describe basic procedures involved in circuit repair *(e.g., use of heat shrink, use of solder and solderless connections)*;

A2.6 describe the operation of various types of protection devices *(e.g., fuses, relays, circuit breakers, fusible links)*;

A2.7 identify various types of batteries *(e.g., gel type, lead acid, lithium ion)* and describe their construction and applications;

A2.8 describe the design and applications of various types of electrical systems *(e.g., ignition systems, lighting systems, starting systems, charging systems)*.

A3. Understanding Major Systems and Components

By the end of this course, students will:

A3.1 identify the function and explain the operation of the major components of various types of steering/control systems;

A3.2 identify the function and explain the operation of the major components of various types of suspension systems *(e.g., coil springs, struts, shocks, air springs)*;

A3.3 identify the function and explain the operation of the major components of various types of brake systems *(e.g., **mechanical:** emergency brake cable; **hydraulic:** master cylinder; **pneumatic:** air brake chamber)*;

A3.4 identify various body components of vehicles, aircraft, and/or watercraft *(e.g., fenders, doors, wheel wells, rocker panels, hull, fuselage, roll-over protection system)*;

A3.5 identify and describe common types of body and frame construction *(e.g., unibody construction, subframe and structural assemblies, hull construction, airframe construction)* in vehicles or craft.

A4. Technological and Mathematical Literacy

By the end of this course, students will:

A4.1 demonstrate appropriate use of technical terminology related to vehicle or craft systems and components and to processes, tools, and equipment commonly used in the transportation industry;

A4.2 define and accurately calculate various measurements related to a vehicle or craft *(e.g., engine displacement, voltage drop)*;

A4.3 prepare reports *(e.g., work orders, journals, parts lists)* for a variety of audiences, using appropriate technical language and relevant technical and mathematical knowledge and skills.

B. TRANSPORTATION TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. demonstrate an understanding of engine operation and repair by performing a variety of service operations;

B2. demonstrate the ability to test and repair basic electrical circuits safely and correctly;

B3. demonstrate the ability to service and repair steering/control, suspension, brake, and body systems;

B4. develop appropriate solutions to transportation technology challenges and/or repair problems.

SPECIFIC EXPECTATIONS

B1. Engine Service and Repair

By the end of this course, students will:

B1.1 access engine specifications, trouble charts, and/or diagnostic procedures from reliable information sources (*e.g., shop manuals, online information, manufacturers' information*) and use them as required to service or repair engines;

B1.2 use a variety of hand, power, and specialty tools safely and correctly to perform basic maintenance and repair procedures (*e.g., maintenance: oil change, tune up; repair: replace the timing belt, repair a fluid leak*) on several types and styles of engines, to manufacturers' specifications;

B1.3 use a variety of tools and equipment (*e.g., fuel pressure/vacuum gauge, compression tester, coolant pressure tester, stethoscope, manometer*) safely and correctly to diagnose basic engine condition;

B1.4 demonstrate correct diagnostic and repair procedures in disassembling and reassembling an engine (*e.g., perform a visual inspection, measure component wear, replace or refurbish components, use proper assembly torque and sequence operations*).

B2. Electrical Circuit Testing and Repair

By the end of this course, students will:

B2.1 demonstrate a working knowledge of inspection and testing of circuits (*e.g., use test lights or multimeters when required, follow correct procedures in performing a voltage drop test*);

B2.2 use a variety of test equipment (*e.g., starter circuit tester, charging system analyser*) to determine continuity and measure voltage, amperage, and resistance in various electrical circuits (*e.g., starting circuits, charging circuits, lighting circuits*);

B2.3 perform repairs on electrical circuits (*e.g., terminal repair, wiring repair*) safely and correctly.

B3. Service and Repair of Steering/Control, Suspension, Brake, and Body Systems

By the end of this course, students will:

B3.1 perform an inspection of steering/control, suspension, brake, and/or body components, and report on their condition, referring to appropriate information sources (*e.g., manufacturers' specifications*) and using appropriate technical language and/or illustrations;

B3.2 perform routine and/or scheduled service procedures on steering/control, suspension, and brake systems (*e.g., lubrication, brake service, suspension inspection, belt and track adjustment, tire service, fluid change*) safely and correctly, using appropriate service information;

B3.3 perform service and repair procedures on various body components, using appropriate fasteners and bonding agents (*e.g., bolts, welds, rivets, clips, adhesives*).

B4. Challenges and Repair Problems

By the end of this course, students will:

B4.1 demonstrate the ability to use a problem-solving process to address a given transportation technology challenge (see pp. 21–23);

B4.2 use relevant mathematical skills and apply appropriate scientific concepts to understand a challenge or perform repairs *(e.g., **math skill:** calculate clearances; **concept applied:** hydraulics; **challenge:** vehicle height modification)*;

B4.3 systematically troubleshoot basic repair problems on a vehicle or craft by using an appropriate diagnostic procedure *(e.g., gather information, perform tests, generate solutions, apply an appropriate solution, test the results)*;

B4.4 identify issues related to a challenge or repair task *(e.g., cost, availability of parts or materials, time required)* and explain how these issues could affect the response to the challenge or the performance of the repair;

B4.5 demonstrate the safe and correct use of a variety of soldering, heating, cutting, and welding techniques when performing tasks related to a challenge or repair.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of environmental issues related to the use of materials and procedures in the service, repair, and recycling of vehicles or craft;

C2. demonstrate an understanding of the relationship between society, vehicle ownership, and various aspects of transportation technology.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 describe the legislative requirements concerning the use of environmentally friendly products in the repair and service of vehicles or craft, and explain the costs and benefits of using such products;

C1.2 explain the importance of the proper processing of waste products *(e.g., batteries, used oil, antifreeze, refrigerant, tires)* as a means of minimizing the environmental impact of the transportation industry;

C1.3 describe appropriate actions to be taken in the event of a spill of waste products *(e.g., gasoline, antifreeze),* and demonstrate the ability to safely implement such actions *(e.g., outline the steps described in an emergency action plan and carry them out).*

C2. Technology and Society

By the end of this course, students will:

C2.1 explain the pros and cons of personal vehicle ownership versus public transit in terms of their effects on society;

C2.2 describe the effects that increasing transportation costs *(e.g., rising fuel costs, highway tolls, environmental taxes)* have on society;

C2.3 explain how current societal needs and preferences influence transportation technology *(e.g., by creating a greater demand for vehicles with improved safety features, fuel efficiency, and emission levels).*

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate the use of professional work practices and procedures and compliance with occupational health and safety regulations and standards;

D2. describe career opportunities in the transportation industry and the education and training required for them.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 identify and explain the importance of legislation and regulations related to procedures and operations used in transportation technology facilities *(e.g., Occupational Health and Safety Act [OHSA]; regulations and standards outlined in the Workplace Hazardous Materials Information System [WHMIS]; Apprenticeship and Certification Act [ACA])*;

D1.2 demonstrate good housekeeping and safety practices in the work environment *(e.g., cleaning up spills and leaks, keeping areas clean and clear of obstructions)*;

D1.3 use protective clothing and equipment *(e.g., eye protection, gloves, breathing mask)* as required to ensure their own and others' safety in the work environment;

D1.4 identify potential health risks *(e.g., brake dust, fumes from brake fluid and brake cleaner)* when servicing vehicles or craft, and demonstrate the use of safe procedures to mitigate these hazards *(e.g., use appropriate ventilation and breathing protection)*;

D1.5 describe and demonstrate the ability to follow appropriate safety precautions required for new technologies when working on vehicles, craft, or power equipment *(e.g., precautions regarding high current and voltage, capacitor discharge rate of supplemental restraint systems, extreme temperature of exhaust systems)*;

D1.6 demonstrate an understanding of professional responsibilities in the transportation industry with regard to personal and public safety *(e.g., quality workmanship, integrity, customer service, compliance with manufacturers' standards)*.

D2. Career Opportunities

By the end of this course, students will:

D2.1 describe a variety of career opportunities in the transportation industry *(e.g., apprenticeship/ trade, parts person, service manager/writer)* and the education and training required for them;

D2.2 describe the regulations regarding restricted skill sets in the Apprenticeship and Certification Act (available at www.e-laws.gov.on.ca);

D2.3 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the transportation industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

D2.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the transportation industry, as identified in the Ontario Skills Passport *(e.g., job task planning and organizing, decision making, finding information)*;

D2.5 demonstrate an understanding of and apply the work habits that are important for success in the transportation industry, as identified in the Ontario Skills Passport *(e.g., working safely, reliability, initiative)*;

D2.6 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in transportation technology *(e.g., Passport to Safety certificate, skills checklist, Ontario Skills Passport Work Plan)*, and explain why having a current portfolio is important for career development and advancement.

Transportation Technology: Vehicle Ownership, Grade 11

Open
TTJ3O

This general interest course enables students to become familiar with the options and features of various vehicles, issues of registration, and the legal requirements affecting vehicle owners. Students will also learn about vehicle financing and insurance, vehicle maintenance, emergency procedures, and the responsibilities of being a vehicle owner. Students will develop an awareness of environmental and societal issues related to vehicle ownership and use, and will explore career opportunities in the transportation industry.

Prerequisite: None

A. VEHICLE OWNERSHIP FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. assess factors affecting decisions on vehicle selection and purchase from an informed consumer's point of view;

A2. demonstrate an understanding of the vehicle registration process and the legal requirements of vehicle ownership;

A3. demonstrate an understanding of loans, leases, and insurance policies related to the purchase or lease of a vehicle;

A4. identify and describe the precautions, procedures, and obligations related to roadside emergencies and accidents.

SPECIFIC EXPECTATIONS

A1. Vehicle Selection

By the end of this course, students will:

A1.1 identify various vehicle makes, models, and body styles and compare their features, options, and price;

A1.2 outline the factors that determine the value of a used vehicle (*e.g., year, mileage, appearance, mechanical condition, warranties, vehicle history, options*);

A1.3 identify the factors that an owner should consider when selecting the most appropriate vehicle to purchase or lease (*e.g., cost, size and type of vehicle, fuel economy [and government incentives, if applicable], ergonomics, intended type and frequency of vehicle use, time of year*) and explain their importance;

A1.4 identify the reasons for "road testing" a vehicle before purchase (*e.g., to determine comfort and visibility, check for noise, test brakes and steering, assess performance and handling*);

A1.5 describe on the basis of research various sales and marketing practices encountered in purchasing or leasing a vehicle (*e.g., high-pressure sales tactics, use of black or red book evaluations*);

A1.6 describe potential issues involved in purchasing a vehicle from various sources (*e.g., dealerships, used car retail outlets, auctions, private sellers, Internet websites*).

A2. Vehicle Registration and Ownership

By the end of this course, students will:

A2.1 describe on the basis of research the legal requirements associated with owning and operating a vehicle (*e.g., fees, taxes, licensing, permits, proof of insurance*);

A2.2 describe the conditions that must be met to register a vehicle (*e.g., safety standards inspection, emissions test, proof of insurance*);

A2.3 explain the purpose of and the protection provided by the Used Vehicle Information Package.

A3. Vehicle Loans and Insurance

By the end of this course, students will:

A3.1 identify appropriate resources for use in the selection of a vehicle loan or lease and insurance policy;

A3.2 explain vehicle insurance coverage requirements and options (*e.g., **requirements:** third-party liability coverage, statutory accident benefits coverage; **options:** collision or upset coverage, comprehensive coverage, loss of vehicle use coverage*);

A3.3 explain the factors that affect the cost of vehicle insurance (*e.g., age and model of vehicle, age and gender of policy holder, driving record*);

A3.4 compare the overall cost of loans from various sources *(e.g., banks, finance companies, private lenders)*;

A3.5 compare the advantages and disadvantages of purchasing versus leasing a vehicle *(e.g., with regard to short-term and long-term costs, ownership, and responsibility for maintenance and repairs)*;

A3.6 describe the criteria financial institutions use to determine eligibility for a loan or lease *(e.g., credit history, income, net worth)*.

A4. Roadside Emergency Precautions and Procedures

By the end of this course, students will:

A4.1 describe the legal consequences and obligations that arise when a driver is involved in an accident and/or charged with a traffic violation *(e.g.,* **consequences:** *fine, charge, legal action;* **obligations:** *show proper documentation, remain at the scene of the accident)*;

A4.2 describe the steps to follow when involved in a traffic accident *(e.g., with respect to law enforcement involvement, exchanging insurance information, making a claim to an insurance company)*;

A4.3 compare various roadside assistance plans *(e.g., manufacturer's plan, aftermarket plan)*;

A4.4 identify safe procedures and recommended techniques *(e.g., for jacking, battery boosting, towing)* described in the owner's manual to resolve roadside emergencies *(e.g., flat tire, dead battery, vehicle breakdown)*;

A4.5 describe the preparations vehicle owners can make to increase driving safety *(e.g., trip planning, driver training, keeping the vehicle properly maintained)*;

A4.6 describe the precautions vehicle owners can take to minimize the effect of accidents or roadside emergencies *(e.g., make sure everyone wears a seatbelt; observe speed limits; have a first aid kit, emergency tool kit, and fire extinguisher in the vehicle; carry a cell phone; wear a helmet when riding a motorcycle)*.

B. VEHICLE MAINTENANCE FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. identify the components and explain the operation of a vehicle powertrain from an owner's perspective;

B2. identify and describe the components and service requirements of major vehicle systems, and related safety precautions, that an owner should be aware of;

B3. describe procedures for the proper care and maintenance of the interior and exterior of a vehicle;

B4. identify appropriate repair information and the tools and equipment required for safe basic service and maintenance of a vehicle.

SPECIFIC EXPECTATIONS

B1. Powertrain Components

By the end of this course, students will:

B1.1 describe the types of powerplants *(e.g., two-stroke, four-stroke, diesel, hybrid)* used in various vehicles;

B1.2 identify the components of engines that require regular servicing *(e.g., oil and oil filter, air filter, spark plugs)*;

B1.3 explain, from an owner's perspective, the basic operation of various engine systems *(e.g., lubrication, cooling, starting, ignition, and fuel systems)* and the related safety and service considerations;

B1.4 explain the operation of vehicle drivetrain components *(e.g., clutch, transmission, driveshaft, differential, axles, track)* and identify those that require regular servicing *(e.g., fluid change, lubrication)*.

B2. Major Vehicle Systems

By the end of this course, students will:

B2.1 locate and identify various components of vehicle systems that an owner should be aware of *(e.g., electrical system – battery; brakes – brake fluid reservoir; steering – tires; suspension – shocks)*;

B2.2 identify typical service requirements *(e.g., fluid change, parts replacement)* and intervals *(e.g., months, kilometres)* related to vehicle systems that an owner should be aware of;

B2.3 identify the product information *(e.g., tire sizing)* and hazards and safety precautions *(e.g., battery explosion – wearing safety glasses)* that an owner should be aware of when servicing vehicle systems.

B3. Interior and Exterior Care

By the end of this course, students will:

B3.1 describe, on the basis of research, interior and exterior vehicle cleaning and protection products and their applications;

B3.2 identify various types and applications of polishes, waxes, and cleaners for vehicle finishes;

B3.3 describe the pros and cons of various types of body corrosion prevention *(e.g., oil, dripless, electronic)* available through vehicle dealerships and aftermarket suppliers;

B3.4 describe various techniques used to make minor repairs to a vehicle's finish *(e.g., stone-chip repair, small-dent repair)*.

B4. Information, Tools, and Equipment for Basic Service and Maintenance

By the end of this course, students will:

B4.1 consult the owner's manual as required for specific procedures, specifications, and products *(e.g., oils, fluids, fuses, bulbs)* related to the maintenance of a vehicle;

B4.2 identify the tools and equipment required by a vehicle owner to perform basic service and maintenance procedures;

B4.3 report on work in progress *(e.g., by completing a work order, parts list, and/or journal),* using terminology specific to vehicles *(e.g., acronyms, service terms);*

B4.4 perform mathematical calculations related to vehicle maintenance and operation that are important from an owner's perspective *(e.g., calculate quantities, ratio of water to antifreeze, fuel consumption),* using appropriate resources *(e.g., owner's manual, service information);*

B4.5 explain the benefits for an owner in keeping up-to-date service and maintenance records.

C. VEHICLE MAINTENANCE SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of service information and the importance of vehicle identification and information labels when performing vehicle maintenance and repair;

C2. perform basic engine and related system service following the owner's manual guidelines and appropriate service information sources, and identify system components that need to be professionally serviced;

C3. perform general vehicle maintenance and service as recommended in the owner's manual and outlined in appropriate service information sources, and identify system components that need to be professionally serviced.

SPECIFIC EXPECTATIONS

C1. Using Service Information

By the end of this course, students will:

C1.1 identify and use appropriate service information sources *(e.g., shop manuals, online information, manufacturer's information)* as required for basic vehicle maintenance and repair;

C1.2 identify the meaning of the letters and numbers of the vehicle identification number (VIN) *(e.g., place of origin, engine size, production year)* on the basis of their placement in the VIN;

C1.3 locate and apply as required information found in the owner's manual and on the vehicle *(e.g., safety warnings, specifications such as tire size and recommended pressure, identification labels, graphics)* when performing basic maintenance and service procedures;

C1.4 locate and correctly interpret graphics commonly found on vehicles and in owner's manuals that depict components being serviced *(e.g., jacking a vehicle, rotating tires, installing a serpentine belt).*

C2. Engine Service

By the end of this course, students will:

C2.1 locate the components of an engine lubrication system *(e.g., oil dipstick, oil filter, oil pan drain plug)* and safely and correctly service the system;

C2.2 locate the components of an engine cooling system *(e.g., cooling fins, radiator cap, radiator hoses)* and safely and correctly service the system *(e.g., perform a freeze point test, system pressure test, boiling point test);*

C2.3 locate the components of an engine starting system *(e.g., battery, battery cables, starting motor)* and safely and correctly service the system *(e.g., clean battery connections, use booster cables);*

C2.4 locate the components of an ignition system *(e.g., spark plugs, ignition wires)* and identify those that need to be professionally serviced;

C2.5 locate the components of an engine fuel system *(e.g., fuel cap, tank and lines, filter)* and identify those that need to be professionally serviced.

C3. General Vehicle Maintenance and Service

By the end of this course, students will:

C3.1 demonstrate the correct use of hand tools and equipment required for basic service and maintenance *(e.g., vehicle jacks, safety stands, wrenches)*, store them safely, and maintain them in good working order;

C3.2 locate the components of the electrical system *(e.g., battery, alternator, fuses, light bulbs)* and perform basic diagnostic and repair procedures *(e.g., check fuse, replace bulb, test and charge battery, install a trailer wiring harness)* safely and correctly;

C3.3 locate the basic components of the brake system *(e.g., rotors, drums, friction material, brake fluid reservoir)* and identify those that need to be professionally serviced;

C3.4 perform basic maintenance procedures related to the steering system *(e.g., basic wheel and tire service, changing a flat tire)* safely and correctly;

C3.5 perform tasks related to a vehicle safety inspection *(e.g., check lights, horn, wipers, glass, door latches and locks)*;

C3.6 apply the proper procedures for maintaining the interior and exterior of a vehicle *(e.g., washing and waxing, upholstery cleaning and protection)*;

C3.7 prepare a vehicle for weather extremes *(e.g., winter cold, summer sun and heat)*;

C3.8 demonstrate an understanding of tasks necessary to prepare a vehicle for long-term and/or short-term storage *(e.g., add fuel system treatment, perform cylinder fogging, lubricate body hinges [on doors, hood, trunk or hatch])*.

D. **TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY**

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. explain how vehicle ownership affects the environment and how vehicle owners can remedy or reduce harmful effects;

D2. explain how vehicle ownership and various aspects of the transportation industry affect society.

SPECIFIC EXPECTATIONS

D1. Technology and the Environment

By the end of this course, students will:

D1.1 outline the legal requirements and environmental reasons for emission standards and for testing when required;

D1.2 describe the options that vehicle owners have to choose environmentally friendly products *(e.g., biodegradable cleaners)* and procedures *(e.g., recycling of antifreeze)* in the repair and service of vehicles;

D1.3 describe a vehicle owner's responsibilities with respect to recycling and/or disposing of waste products *(e.g., used oil, used batteries)* appropriately;

D1.4 explain the importance of vehicle maintenance from an environmental perspective *(e.g., keeping tires properly inflated helps to maximize fuel efficiency and reduce emissions).*

D2. Technology and Society

By the end of this course, students will:

D2.1 analyse the safety features in today's vehicles *(e.g., electronic stability control, airbags, anti-lock brakes, roll-over protection, engine kill switch)* from a consumer's point of view;

D2.2 describe the economic, environmental, and social effects that various aspects of the transportation industry have on a community *(e.g., economic: new businesses encouraged by good transportation links; environmental: pollution caused by exhaust emissions and road salting; social: community links expanded through personal vehicle use);*

D2.3 assess from a consumer's point of view the pros and cons *(e.g., cost, availability, performance, reliability, emission levels)* of various types of fuel/energy sources used to power vehicles *(e.g., gasoline, propane, diesel, electrical/battery power, biodiesel, hybrid powerplant).*

E. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

E1. demonstrate an understanding of and compliance with occupational health and safety regulations and standards related to vehicle maintenance;

E2. identify and describe career opportunities in the transportation industry and the education and training required for these careers.

SPECIFIC EXPECTATIONS

E1. Health and Safety

By the end of this course, students will:

E1.1 identify and explain the importance of legislation and regulations related to procedures and operations used in transportation technology facilities *(e.g., Occupational Health and Safety Act [OHSA]; regulations and standards outlined in the Workplace Hazardous Materials Information System [WHMIS])*;

E1.2 demonstrate good housekeeping and safety practices in the work environment *(e.g., cleaning up spills and leaks, keeping areas clean and clear of obstructions)*;

E1.3 use protective clothing and equipment *(e.g., safety glasses, hearing protection)* as required to ensure their own and others' safety in the work environment.

E2. Career Opportunities

By the end of this course, students will:

E2.1 describe a variety of career opportunities in the transportation industry and the education and training required;

E2.2 identify groups and programs that are available to support students who are interested in pursuing non-traditional career choices in the transportation industry *(e.g., mentoring programs, virtual networking/support groups, specialized postsecondary programs, relevant trade/industry associations)*;

E2.3 demonstrate an understanding of and apply the Essential Skills that are important for success in the transportation industry, as identified in the Ontario Skills Passport *(e.g., finding information, measurement and calculation, decision making)*;

E2.4 demonstrate an understanding of and apply the work habits that are important for success in the transportation industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability)*;

E2.5 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in transportation technology *(e.g., Passport to Safety certificate, skills checklist, Ontario Skills Passport Work Plan)*, and explain why having a current portfolio is important for career development and advancement.

Transportation Technology, Grade 12

College Preparation   TTJ4C

This course enables students to further develop technical knowledge and skills as they study, test, service, and repair engine management systems; powertrains; steering/control, suspension, brake, and body systems on vehicles, aircraft, and/or watercraft; and/or small-engine products. Students will refine communication and teamwork skills through practical tasks, using a variety of tools and equipment. Students will expand their awareness of environmental and societal issues related to transportation and their knowledge of apprenticeship and college programs leading to careers in the transportation industry.

Prerequisite: Transportation Technology, Grade 11, College Preparation

A. TRANSPORTATION TECHNOLOGY FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate an understanding of the operation of engine management systems;

A2. demonstrate an understanding of the principles of operation of power transfer devices;

A3. demonstrate an understanding of troubleshooting techniques used to diagnose problems in powertrain systems;

A4. assess the effect of modifying a vehicle, aircraft, or watercraft;

A5. demonstrate accurate and appropriate use of technical and mathematical knowledge and skills in the study of transportation technology.

SPECIFIC EXPECTATIONS

A1. Understanding Engine Management Systems

By the end of this course, students will:

A1.1 measure and explain the correlations among voltmeter, ammeter, and ohmmeter measurements of an electric or electronic circuit (*e.g., effect of resistance on voltage, relationship of resistance to voltage drop*);

A1.2 identify and describe sensors, actuators, transducers, and control devices commonly used in engine management systems;

A1.3 explain the principles of operation of various engine management systems (*e.g., emission control, multiplexing, fuel delivery management, ignition timing management*) and describe how these systems are interrelated;

A1.4 explain how environmentally harmful gases are produced through combustion and how the engine management systems control the level of emissions in the exhaust gas (*e.g., through after-treatment of exhaust gases, exhaust gas recirculation, vapour recovery, positive crankcase ventilation, variable valve timing*);

A1.5 explain how engine management systems may be affected by lubrication and coolant systems requiring maintenance (*e.g., a thermostat stuck open will cause the engine to run below optimal operating temperature, causing excessive fuel consumption*).

A2. Understanding Power Transfer Devices

By the end of this course, students will:

A2.1 describe how energy is converted into motion (*e.g., chemical to mechanical, chemical to electrical, electrical to mechanical*);

A2.2 compare the torque and power characteristics of various power sources (*e.g., two-stroke, four-stroke, gasoline, diesel, electric, fuel cell, hybrid, turboprop, jet*);

A2.3 evaluate the performance of various power sources (*e.g., in terms of transmission output, hydraulic efficiency, volumetric efficiency, horsepower, torque*);

A2.4 identify and trace the flow of power through the major components of a drivetrain (*e.g., transmission to axle, outboard drive, snowmobile drive, hydrostatic drive*);

A2.5 describe power flow, gear ratios, and torque multiplication in common mechanical drive systems (*e.g., belt, chain, and gear drive systems; variable speed pulleys; planetary gear sets; clutch drives*).

A3. Troubleshooting the Powertrain

By the end of this course, students will:

A3.1 systematically troubleshoot problems in vehicles or craft by using appropriate diagnostic

steps *(e.g., gather information, generate solutions, choose and apply a solution, validate the repair)* and equipment *(e.g., scan tool, multimeter, break-out box)*;

A3.2 repair various problems in the powertrain system *(e.g., no start; problems with starting system, charging system, ignition system)*;

A3.3 describe symptoms *(e.g., noise, vibration, odour, drag)* resulting from failure or improper assembly of various powertrain components *(e.g., vehicle height has dropped due to a broken coil spring, causing the driveshaft/axle working angle to exceed the manufacturer's specifications; pulleys are misaligned, causing premature belt wear)*, and recommend appropriate repairs.

A4. Modifying Vehicles and/or Craft

By the end of this course, students will:

A4.1 explain the effects that body modifications *(e.g., race kits, lift kits, spoilers, ground effects)* have on vehicle or craft dynamics;

A4.2 explain the effects that vehicle or craft modifications *(e.g., changing tire size, modifying fuel and exhaust systems, changing electronic control modules [ECMs], installing lift and lower kits)* have on interrelated mechanical systems.

A5. Technological and Mathematical Literacy

By the end of this course, students will:

A5.1 demonstrate correct and appropriate use of technical terminology when preparing documentation commonly used in the transportation industry *(e.g., trouble trees, flow charts, work orders, technical service bulletins)*;

A5.2 define and correctly calculate measurements related to vehicles or craft *(e.g., gear ratios, rotor run-out, engine displacement, efficiencies, output)*;

A5.3 demonstrate an understanding of scientific concepts *(e.g., direct and alternating current, expansion when heat is added)* as they apply to service and repair procedures;

A5.4 prepare technical reports *(e.g., work orders, journals, parts lists)* for a variety of audiences, using appropriate language and demonstrating competent writing skills and appropriate computer literacy skills.

B. TRANSPORTATION TECHNOLOGY SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. demonstrate the use of a variety of troubleshooting techniques to service and repair engine management systems;

B2. inspect, service, and repair drivetrain components in compliance with manufacturers' standards;

B3. use proper procedures for the inspection, servicing, and repair of steering/control, suspension, brake, and body systems;

B4. develop appropriate solutions to a variety of repair challenges.

SPECIFIC EXPECTATIONS

B1. Troubleshooting Engine Management Systems

By the end of this course, students will:

B1.1 access and correctly interpret data provided by the on-board diagnostic system *(e.g., dash codes, on-board diagnostic [OBD] data)*;

B1.2 use trouble charts and manufacturers' diagnostic procedures correctly and appropriately to service problems indicated by on-board diagnostic data;

B1.3 use appropriate equipment to diagnose and repair engine control systems and components *(e.g., sensors, actuators, control devices)* according to manufacturers' recommendations;

B1.4 demonstrate proper use of diagnostic equipment to avoid damage to equipment and/or vehicle or craft components *(e.g., damage caused by a short circuit, a voltage spike, an ammeter connected in series)*.

B2. Service and Repair of Drivetrain Components

By the end of this course, students will:

B2.1 inspect and diagnose problems in drivetrain components *(e.g., transmission, clutch, driveshaft, outboard drive)* in compliance with manufacturers' standards;

B2.2 perform service procedures on drivetrain components *(e.g., replace and adjust clutch, replace universal joints, replace/repack bearings, replace drive seals, adjust belt or chain)* safely and correctly.

B3. Service and Repair of Steering/Control, Suspension, Brake, and Body Systems

By the end of this course, students will:

B3.1 inspect and measure component tolerances when servicing steering/control, suspension, and brake systems and body component alignment *(e.g., **steering/control systems:** tire wear, ball joint play; **suspension systems:** ride height/ trim height; **brake systems:** disc thickness, drum diameter; **body alignment:** door opening)*, and compare the results with manufacturers' specifications;

B3.2 demonstrate proper procedures and the safe use of specialty tools and equipment in the service and repair of steering/control, suspension, brake, and body system components *(e.g., **steering/control:** tie rod fork, tire balancer; **suspension:** coil spring compressor; **brakes:** lathe, dial indicator gauge; **body:** metal inert gas [MIG] welder)*.

B4. Solving Repair Challenges

By the end of this course, students will:

B4.1 access and use appropriate resources *(e.g., repair manuals, online resources, equipment instructions)* as required to successfully address repair challenges;

B4.2 demonstrate the safe and correct use of a variety of soldering, heating, cutting, and/or welding equipment for service repair and modification tasks;

B4.3 perform an inspection for various repair challenges *(e.g., brake service, ball-joint replacement, driveshaft or belt misalignment, transmission repair)* and prepare a report on work to be done, including a cost-benefit analysis.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of environmental issues in the transportation industry, and use best practices to remedy or reduce the environmental effects of using specific products or processes;

C2. assess the effects that various aspects of the transportation industry have on society.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 demonstrate an understanding of ways in which the transportation industry affects the environment and of efforts being made to remedy or reduce harmful effects *(e.g., improved production methods, automotive parts recycling)*, including ways of disposing of waste products *(e.g., used oil, used batteries, used paints/thinners)*;

C1.2 describe appropriate actions to be taken in the event of a spill of waste products *(e.g., gasoline, antifreeze)* and demonstrate the ability to safely implement such actions *(e.g., implement an emergency action plan to contain and clean up the spill)*;

C1.3 identify the procedures required to prevent the release of ozone-depleting materials and other harmful substances *(e.g., electrolyte, antifreeze, gasoline)* during the servicing of vehicle or craft systems.

C2. Technology and Society

By the end of this course, students will:

C2.1 assess the economic effects of the transportation industry on the local and global levels;

C2.2 assess the importance to society of a transportation infrastructure *(e.g., highway system, rail system, canal system)*;

C2.3 evaluate the potential benefits *(e.g., technical, safety, financial, business)* to society of emerging technologies related to the transportation industry *(e.g., collision avoidance system, run-flat tires, fuel cells, composite materials)*;

C2.4 assess the pros and cons of various types of fuel/energy sources *(e.g., gasoline, propane, diesel, electrical/battery power, biodiesel, hybrid powerplant, hydrogen power cells)* used to power vehicles or small-engine products, taking into account a variety of perspectives *(e.g., consumer's perspective: cost to purchase, cost to operate, performance, emission levels; service/repair perspective: training, safety issues, new tools/equipment required)*.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate the use of professional work practices and procedures and compliance with occupational health and safety regulations and standards;

D2. describe career opportunities in the transportation industry and the training and qualifications required for them.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 demonstrate an understanding of legislation and regulations related to procedures and operations used in transportation technology facilities *(e.g., Occupational Health and Safety Act [OHSA]; regulations and standards outlined in the Workplace Hazardous Materials Information System [WHMIS]; Apprenticeship and Certification Act [ACA])*;

D1.2 demonstrate good housekeeping and safety practices in the work environment *(e.g., cleaning up spills and leaks, keeping areas clean and clear of obstructions)*;

D1.3 identify potential health risks *(e.g., asbestos dust, fumes from brake fluid and cleaners)* when servicing vehicles or craft, and demonstrate the use of safe procedures to mitigate these hazards *(e.g., use appropriate ventilation and breathing protection)*;

D1.4 use protective clothing and equipment *(e.g., eye and hearing protection, gloves, breathing apparatus, hoist, safety stand)* as required to ensure their own and others' safety in the work environment;

D1.5 explain the need for and demonstrate the ability to follow appropriate safety precautions applicable to new technologies when working around or servicing vehicles, craft, or power equipment *(e.g., precautions regarding high current and voltage, capacitor discharge rate of supplemental restraint systems, extreme temperature of exhaust systems, accumulators in hydraulic systems, pressure vessels)*;

D1.6 demonstrate an understanding of professional responsibilities in the transportation industry with regard to personal and public safety *(e.g.,*

good workmanship, integrity, high-quality customer service, compliance with manufacturers' standards).

D2. Career Opportunities

By the end of this course, students will:

D2.1 describe on the basis of research the qualifications required for careers in the transportation industry *(e.g., apprenticeship standards, certifications, licensing requirements)*;

D2.2 identify the regulations regarding restricted skill sets in the Apprenticeship and Certification Act (available at www.e-laws.gov.on.ca);

D2.3 demonstrate an understanding of the need for continuous learning and skill upgrading created by emerging technological developments *(e.g., high voltages in hybrid vehicles, alternative fuels, new types of refrigerant)* and the changing repair techniques required for modern vehicles and craft;

D2.4 demonstrate an understanding of and apply the Essential Skills that are important for success in the transportation industry, as identified in the Ontario Skills Passport *(e.g., decision making, problem solving, finding information)*;

D2.5 demonstrate an understanding of and apply the work habits that are important for success in the transportation industry, as identified in the Ontario Skills Passport *(e.g., teamwork, reliability, initiative)*;

D2.6 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in transportation technology *(e.g., Passport to Safety certificate, skills checklist, Ontario Skills Passport Work Plan and Transition Plan)*, and explain why having a current portfolio is important for career development and advancement.

Transportation Technology: Vehicle Maintenance, Grade 12

Workplace Preparation   **TTJ4E**

This course introduces students to the servicing, repair, and maintenance of vehicles through practical applications. The course is appropriate for all students as a general interest course to prepare them for future vehicle operation, care, and maintenance or for entry into an apprenticeship in the motive power trades. Students will develop an awareness of environmental and societal issues related to transportation, and will learn about careers in the transportation industry and the skills and training required for them.

Prerequisite: None

A. VEHICLE MAINTENANCE FUNDAMENTALS

OVERALL EXPECTATIONS

By the end of this course, students will:

A1. demonstrate a working knowledge of the components and principles of operation of a vehicle powertrain and the procedures involved in servicing it;

A2. demonstrate an understanding of the interior and exterior care and maintenance of a vehicle;

A3. demonstrate a working knowledge of the technical requirements, procedures, tools and equipment, and documentation connected with servicing and maintaining a vehicle or small-engine product.

SPECIFIC EXPECTATIONS

A1. Vehicle Powertrains

By the end of this course, students will:

A1.1 identify the components of an internal combustion engine and describe its operation and the routine service required to keep it operating at peak efficiency;

A1.2 explain the similarities and differences among various engine cycles (*e.g., two-stroke, four-stroke, rotary, turbine*);

A1.3 explain powertrain terminology commonly used in the transportation industry (*e.g., double overhead camshaft [DOHC], automatic transmission [A/T], all-wheel drive [AWD]*);

A1.4 identify the components of a vehicle drivetrain (*e.g., constant velocity [C/V] joints and boots, axles, chain or belt drive, power take-off [PTO], transmission*) and describe the operation of a drivetrain and the routine service required to keep it operating at peak efficiency.

A2. Interior and Exterior Care and Maintenance

By the end of this course, students will:

A2.1 describe, on the basis of research, a variety of interior vehicle cleaning products and their applications;

A2.2 identify the types of polishes, waxes, and cleaners that are appropriate for various vehicle finishes (*e.g., exterior base clear coat, gel coat*);

A2.3 describe various repair techniques and make minor repairs to a vehicle body finish (*e.g., stone-chip repair, small-dent repair*);

A2.4 identify and describe various types of fastening methods (*e.g., welding, nut and bolt, riveting, chemical bonding*) used in maintenance procedures for vehicles and small-engine products;

A2.5 identify the consequences and legal implications of various vehicle customizations (*e.g., ground effects, body alterations, audio systems, light intensity, window tinting*).

A3. Service and Maintenance

By the end of this course, students will:

A3.1 locate appropriate information sources (*e.g., shop manuals, owner's manual, online databases*) and consult as required for specifications, tools, equipment, and procedures used in servicing and maintaining vehicles or small-engine products;

A3.2 locate, use, and correctly interpret assembly drawings that depict the components of vehicle systems or small-engine products;

A3.3 identify and describe the function of common hand tools (*e.g., wrenches, socket/ratchet set, screwdrivers*), power tools (*e.g., electric drill, die grinder, air ratchet*), and equipment (*e.g., battery charger, hoist, parts washer*) used in servicing and maintaining a vehicle or small-engine product;

A3.4 identify and describe the function of common measuring tools (*e.g., micrometer, hydrometer, multimeter*) used in servicing and maintaining a vehicle or small-engine product;

A3.5 perform mathematical calculations related to servicing and maintaining a vehicle or small-engine product *(e.g., calculate quantities, ratio of water to antifreeze, fuel consumption)*, using appropriate resources *(e.g., owner's manual, service information)*;

A3.6 report on work in progress and work performed *(e.g., by completing a work order, parts list, service record, and/or journal)*, using appropriate terminology specific to vehicles or small-engine products *(e.g., acronyms, service terms)*.

B. VEHICLE MAINTENANCE SKILLS

OVERALL EXPECTATIONS

By the end of this course, students will:

B1. perform general service and maintenance on vehicles or small-engine products safely, using the owner's manual, repair manuals, tool and equipment manuals, and identification and information labels;

B2. inspect, test, and service powertrain components, using appropriate service repair resources;

B3. demonstrate a basic understanding of body, brake, steering, and suspension systems and components, and procedures required for their maintenance and service;

B4. develop appropriate solutions to various vehicle repair problems or challenges.

SPECIFIC EXPECTATIONS

B1. Service Information

By the end of this course, students will:

B1.1 identify the meaning of the letters and numbers of the vehicle identification number (VIN) *(e.g., place of origin, engine size, production year)* on the basis of their placement in the VIN;

B1.2 locate information in the owner's manual and on the vehicle or small-engine product *(e.g., safety warnings, warning light and icon information, computer trouble codes, specifications such as tire size and recommended pressure, identification labels, graphics)* and apply as required when performing service and maintenance procedures;

B1.3 identify procedures recommended in the owner's manual and/or repair manual for emergency situations *(e.g., flat tire, dead battery, vehicle breakdown)*;

B1.4 demonstrate the correct use of hand, power, machine, and pneumatic tools and equipment required for service tasks *(e.g., tire machine, floor jacks and hoists, safety stands, shop tools)*, store them safely, and maintain them in good working order;

B1.5 remove and replace components *(e.g., engine oil, tires)* correctly, using appropriate product information and specifications *(e.g., engine oil – viscosity and quantity; tires – tire size and load rating)* as noted in the owner's manual and/or repair manual;

B1.6 demonstrate the safe operation of a variety of heating, cutting, and welding equipment in performing service and maintenance tasks.

B2. Powertrain Systems

By the end of this course, students will:

B2.1 perform service procedures on an engine lubrication system *(e.g., change engine oil, change oil filter)* safely and correctly;

B2.2 perform inspection and service procedures on an engine fuel system *(e.g., change fuel filter)* safely and correctly;

B2.3 perform inspection, testing, and service procedures on an engine cooling system *(e.g., perform pressure test, test freezing/boiling point)* safely and correctly;

B2.4 perform inspection and service procedures on an engine ignition system *(e.g., replace spark plugs, replace ignition wires)* safely and correctly;

B2.5 perform inspection, testing, and service procedures on an electrical system *(e.g., test fuses, charge battery, inspect alternator)* safely and correctly;

B2.6 identify drivetrain components *(e.g., transmission dipstick, differential fill plug, transfer case level plug)* and perform drivetrain maintenance and service *(e.g., clutch adjustment, fluid level checks)* safely and correctly;

B2.7 perform inspection and service procedures on an engine exhaust system *(e.g., replace a muffler)* safely and correctly.

B3. Body, Brake, Steering, and Suspension Systems

By the end of this course, students will:

B3.1 locate and identify the major components of body, brake, steering, and suspension systems *(e.g., fender, emergency brake, pneumatic air brake components, tires, hydraulic steering and brake components, shocks)*;

B3.2 correctly interpret assembly drawings that depict the components of body, brake, steering, and suspension systems;

B3.3 perform maintenance and service procedures related to body, brake, steering, and suspension systems *(e.g., **body:** hood or door adjustment, paint or finish maintenance; **brakes:** disc and drum brake service, air brake service; **steering:** tire and wheel service, hydraulic component service, repacking trailer bearings; **suspension:** strut and shock inspection)*;

B3.4 repair minor damage to body components *(e.g., panels, lights)* as required to maintain a vehicle in good condition.

B4. Repair Problems or Challenges

By the end of this course, students will:

B4.1 demonstrate the use of an appropriate diagnostic problem-solving process *(e.g., use of flow charts)* to solve a repair problem *(e.g., no-start condition, no-charging condition)*;

B4.2 design and fabricate a transportation-related project *(e.g., a welding/metal fabrication project)* in response to a challenge, using appropriate tools, equipment, and processes;

B4.3 report on the repair process or project and its results, and identify possible further repair/ service or improvements after completing and testing the repair solution or project.

C. TECHNOLOGY, THE ENVIRONMENT, AND SOCIETY

OVERALL EXPECTATIONS

By the end of this course, students will:

C1. demonstrate an understanding of ways in which various aspects of the transportation industry affect the environment, and ways in which harmful effects can be remedied or reduced;

C2. demonstrate an understanding of the relationship between various aspects of the transportation industry and society.

SPECIFIC EXPECTATIONS

C1. Technology and the Environment

By the end of this course, students will:

C1.1 demonstrate an understanding of ways in which the transportation industry affects the environment and of efforts being made to remedy or reduce harmful effects *(e.g., improved production methods, automotive parts recycling)*, including ways of disposing of waste products *(e.g., used oil, used batteries, used paints/thinners)*;

C1.2 explain the pros and cons of using environmentally friendly products *(e.g., biodegradable cleaners)* and procedures *(e.g., recycling of antifreeze)* in the repair and service of vehicles or small-engine products;

C1.3 describe appropriate actions to be taken in the event of a spill of waste products *(e.g., used oil, antifreeze, fuel)*, and demonstrate the ability to safely implement such actions *(e.g., outline the steps described in an emergency action plan and carry them out)*.

C2. Technology and Society

By the end of this course, students will:

C2.1 research and report on the development of improved safety features in today's vehicles or small-engine products *(e.g., airbags, anti-lock brakes, electronic stability control, back-up alarms, engine kill switch, no-mow-in-reverse switch)*;

C2.2 assess the pros and cons of various types of fuel/energy sources *(e.g., gasoline, propane, diesel, electrical/battery power, biodiesel, hybrid powerplant, hydrogen power cells)* used to power vehicles or small-engine products, taking into account a variety of perspectives *(e.g., consumer's perspective: cost to purchase, cost to operate, performance, emission levels; service/repair perspective: training, safety issues, new tools/equipment required)*;

C2.3 explain how current trends in transportation technology *(e.g., extended maintenance schedules, improved emission standards and testing, use of high-tech components, emphasis on fuel efficiency, manufacturers' efforts to increase the amount of recyclable material in vehicles and small-engine products)* are related to societal attitudes and behaviour.

D. PROFESSIONAL PRACTICE AND CAREER OPPORTUNITIES

OVERALL EXPECTATIONS

By the end of this course, students will:

D1. demonstrate an understanding of and compliance with occupational health and safety regulations and standards;

D2. identify and describe career opportunities in the transportation industry and the skills and training required for entry into these careers.

SPECIFIC EXPECTATIONS

D1. Health and Safety

By the end of this course, students will:

D1.1 demonstrate an understanding of legislation and regulations related to procedures and operations used in transportation technology facilities *(e.g., Occupational Health and Safety Act [OHSA]; regulations and standards outlined in the Workplace Hazardous Materials Information System [WHMIS]; Apprenticeship and Certification Act [ACA])*;

D1.2 demonstrate good housekeeping and safety practices in the work environment *(e.g., cleaning up spills and leaks, keeping areas clean and clear of obstruction)*;

D1.3 use protective clothing and equipment *(e.g., eye protection, breathing apparatus)* as required to ensure their own and others' safety in the work environment;

D1.4 describe and demonstrate the ability to follow safety precautions applicable to new technologies when working around or servicing vehicles *(e.g., precautions regarding high current and voltage, capacitor discharge rate of supplemental restraint systems, extreme temperature of exhaust systems)*;

D1.5 identify potential health risks when servicing vehicles and demonstrate the use of safe procedures to mitigate these hazards *(e.g., preventive measures to minimize airborne particles and fumes)*.

D2. Career Opportunities

By the end of this course, students will:

D2.1 describe a variety of career opportunities in the transportation industry and the training required for entry into these careers;

D2.2 demonstrate an understanding of and apply the Essential Skills that are important for success in the transportation industry, as identified in the Ontario Skills Passport *(e.g., problem solving, finding information, measurement and calculation)*;

D2.3 demonstrate an understanding of and apply the work habits that are important for success in the transportation industry, as identified in the Ontario Skills Passport *(e.g., working safely, teamwork, reliability)*;

D2.4 maintain an up-to-date portfolio that includes pieces of work and other materials that provide evidence of their skills and achievements in transportation technology *(e.g., Passport to Safety certificate, skills checklist, Ontario Skills Passport Work Plan and Transition Plan)*, and explain why having a current portfolio is important for career development and advancement.