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Ministry of Education

The Ontario Curriculum
Grades 11 and 12

Technological Education

2000

Contents

Introduction 3

The Place of Technological Education in the Curriculum 3

The Program in Technological Education 5

Overview 5

Teaching Approaches 12

Curriculum Expectations 12

Strands 13

Part A: Broad-Based Technology 15

Communications Technology 16

Overview 16

Courses

Communications Technology, Grade 11, University/College Preparation (TGJ3M) 17

Communications Technology, Grade 11, Workplace Preparation (TGJ3E) 23

Communications Technology, Grade 12, University/College Preparation (TGJ4M) 29

Communications Technology, Grade 12, Workplace Preparation (TGJ4E) 34

Construction Technology 39

Overview 39

Courses

Construction Technology, Grade 11, College Preparation (TCJ3C) 40

Construction Technology, Grade 11, Workplace Preparation (TCJ3E) 46

Construction Technology, Grade 12, College Preparation (TCJ4C) 52

Construction Technology, Grade 12, Workplace Preparation (TCJ4E) 58

Health and Personal Services 64

Overview 64

Courses

Health Care, Grade 11, College Preparation (TPA3C) 65

Hairstyling and Aesthetics, Grade 11, Workplace Preparation (TPE3E) 69

Child Development and Gerontology, Grade 12, College Preparation (TPO4C) 73

Medical Technologies, Grade 12, College Preparation (TPT4C) 78

Hairstyling and Aesthetics, Grade 12, Workplace Preparation (TPE4E) 82

Une publication équivalente est disponible en français sous le titre suivant : *Le curriculum de l'Ontario, 11e et 12e année – Éducation technologique, 2000*.

This publication is available on the Ministry of Education's website at http://www.edu.gov.on.ca.

Hospitality and Tourism 87
Overview 87
Courses
Hospitality, Grade 11, College Preparation (TFT3C) 88
Hospitality and Tourism, Grade 11, Workplace Preparation (TFH3E) 93
Tourism, Grade 12, College Preparation (TFS4C) 97
Hospitality and Tourism, Grade 12, Workplace Preparation (TFH4E) 101

Manufacturing Technology 105
Overview 105
Courses
Manufacturing Engineering Technology, Grade 11, College Preparation (TMJ3C) 106
Manufacturing Technology, Grade 11, Workplace Preparation (TMJ3E) 111
Manufacturing Engineering Technology, Grade 12, College Preparation (TMJ4C) 117
Manufacturing Technology, Grade 12, Workplace Preparation (TMJ4E) 123

Technological Design 128
Overview 128
Courses
Technological Design, Grade 11, University/College Preparation (TDJ3M) 129
Technological Design, Grade 11, Workplace Preparation (TDJ3E) 133
Technological Design, Grade 12, University/College Preparation (TDJ4M) 137
Technological Design, Grade 12, Workplace Preparation (TDJ4E) 141

Transportation Technology 145
Overview 145
Courses
Transportation Technology, Grade 11, College Preparation (TTJ3C) 146
Transportation Technology, Grade 11, Workplace Preparation (TTJ3E) 152
Transportation Technology, Grade 12, College Preparation (TTJ4C) 156
Transportation Technology, Grade 12, Workplace Preparation (TTJ4E) 162

Part B: Computer Studies 169

Computer and Information Science 170
Overview 170
Courses
Computer and Information Science, Grade 11 University/College Preparation (ICS3M) . . 171
Computer and Information Science, Grade 12, University/College Preparation (ICS4M) . . 177

Computer Engineering 182
Overview 182
Courses
Computer Engineering, Grade 11, University/College Preparation (ICE3M) 183
Computer Engineering, Grade 11, Workplace Preparation (ICE3E) 187
Computer Engineering, Grade 12, University/College Preparation (ICE4M) 191
Computer Engineering, Grade 12, Workplace Preparation (ICE4E) 195

Some Considerations for Program Planning in Technological Education 199

The Achievement Chart for Technological Education 202

Introduction

The Ontario Curriculum, Grades 11 and 12: Technological Education, 2000 will be implemented in Ontario secondary schools starting in September 2001 for students in Grade 11 and in September 2002 for students in Grade 12. This document replaces the sections of the following curriculum guidelines that relate to the senior grades:

– *Broad-based Technological Education, Grades 10, 11, and 12, 1995*
– *Computer Studies, Intermediate and Senior Divisions, 1983*
– *Computer Studies, Ontario Academic Course, 1987*
– *Technological Studies, Intermediate and Senior Divisions, Part C: Ontario Academic Courses, 1987*

This document is designed for use in conjunction with *The Ontario Curriculum, Grades 9 to 12: Program Planning and Assessment, 2000*, which contains information relevant to all disciplines represented in the curriculum. The planning and assessment document is available both in print and on the ministry's website, at http://www.edu.gov.on.ca.

The Place of Technological Education in the Curriculum

Technological innovation influences all areas of life, from the actions of individuals to those of nations. It addresses basic human needs and provides the tools and processes required for the exploration of both the known and the unknown world.

The power of technology, its pervasiveness, and its continual advances demand a rigorous curriculum and the commitment of educators to understand it, promote its responsible use, and enable students to become problem solvers who are self-sufficient, entrepreneurial, and technologically literate. Students must acquire the technological skills and knowledge required to participate in a competitive, global economy. They must become critical and innovative thinkers, able to question, understand, and respond to the implications of technological innovation, as well as to find solutions and develop products.

Technological education focuses on developing students' ability to work creatively and competently with technologies that are central to their lives. Their development as technologically literate individuals throughout elementary and secondary school enhances their success in postsecondary studies and in the workplace. The policy outlined in this secondary school curriculum document is designed to ensure that technological education in Ontario meets the challenges and opportunities of the twenty-first century.

Technological education promotes the integration of learning across subject disciplines. For example, in designing a technological tool, students may gain information about its intended use (social science), about the materials used in its construction (science), about mathematical relationships describing its dimensions and shape (mathematics), and about the aesthetic qualities of its design (the arts); they may also create text that outlines procedures for the tool's use (language). Similarly, technology supports students' work in other subjects. It develops research skills, supports development in literacy and mathematics, and fosters creativity, critical thinking, and problem solving. In addition, it promotes global citizenship and environmental awareness.

Technological education contributes to learning in other areas of the curriculum by providing practical contexts and applications for the knowledge and skills acquired. For example, the technological education program relates to science in that students use scientific principles to design buildings and machines, and to history, the social sciences, and the humanities in that students assess the impact of the introduction of technologies on historical and current events. Technological education relies on English and literacy skills for the description of specifications, proposals, and evaluations, and has ties to the arts through its use of various media to model and present ideas and products. In technological education, students also consider the options provided by various technologies as they affect health and physical well-being. The connection to business studies is evident in the application of business principles to the study of the production and marketing of products in technological education.

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 organization of expectations in strands flows from the elementary science and technology curriculum into the secondary curriculum in technological education. In this continuum, there is a similar emphasis on key ideas (theory and foundation), technological processes (skills and processes), and the relationship between technology and the world (impact and consequences).

The Program in Technological Education

Overview

The technological education program in Grades 11 and 12 encompasses both broad-based technology and computer studies, each involving a unique approach to curriculum content and delivery. Courses in broad-based technology are described in Part A of this document, and courses in computer studies are described in Part B.

Part A: Broad-Based Technology. The philosophy that underlies the teaching of broad-based technology is that students learn best by doing. The curriculum in this area takes an activity-based, project-driven approach to learning that provides students with knowledge, skills, and experiences in the subjects of their choice. Courses are offered in the following subjects:

- communications technology
- construction technology
- health and personal services
- hospitality and tourism
- manufacturing technology
- technological design
- transportation technology

Each area of study is based on a broad, systematic framework of ten concepts that describe the different types of technological knowledge and skills. It is important for students to understand and use these concepts, which can assist them in analysing and classifying technological problems and identifying the most effective ways of solving those problems. The ten concepts that provide the framework for technological education are as follows:

1. *Structure:* The essential physical or conceptual parts of a product, process, or system, including the way in which the parts are constructed or organized.
2. *Material:* The substances or information used to make the structure.
3. *Fabrication:* The act or process of forming and assembling materials and structures.
4. *Mechanism*: The parts of a structure that allow it to work or function.
5. *Power and energy:* The resource that enables a mechanism to perform work.
6. *Controls:* The means by which a mechanism is activated and regulated.
7. *Systems:* The combinations of interrelated parts (structures and/or mechanisms) that make up a whole and that may be connected with other systems.
8. *Function:* The use for which a product, process, or system is developed.
9. *Aesthetics:* The aspects of a product, process, or system that make it pleasing to the human senses.
10. *Ergonomics:* The aspects of a product, process, or system that allow people to use it efficiently – that is, with minimal waste of time or energy.

Part B: Computer Studies. In computer studies, the computer itself is the object of study. Computer studies is concerned with how computers represent objects (e.g., a list of names, a graphical image, an electronic circuit) and how they receive and process instructions to manipulate these representations. Courses are offered in the following subjects:

– computer and information science

– computer engineering

Courses and Credits. In Grades 11 and 12, three types of courses are offered in the technological education curriculum: university/college preparation, college preparation, and workplace preparation courses. (See *The Ontario Curriculum, Grades 9 to 12: Program Planning and Assessment, 2000* for a description of the various types of secondary school courses.)

Courses in Grades 11 and 12 are designed to be offered as full-credit courses. However, half-credit courses may be developed for specialized programs, such as school-work transition and apprenticeship programs, as long as the original course is not designated as a requirement for entry into a university program. Individual universities will identify the courses that are prerequisites for admission to specific programs. Such courses must be offered as full-credit courses, to ensure that students meet admission requirements.

In Grades 9-12, half-credit courses, which require a minimum of 55 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, drawn from all of the strands of that course and 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 that 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 September Report.

In broad-based technology, courses in Grades 10, 11, and 12 that lead to apprenticeship or certification programs or that are part of school-work transition programs may be planned for up to 330 hours of scheduled instructional time. This additional instructional time allows for the practice and refinement of skills needed to raise the quality of students' performance to the levels required for certification, entry into apprenticeship programs, or participation in school-work transition programs. (It may also support articulation agreements for advanced standing or preferred entrance into specialized programs.) Instructional time may be increased by increments of 55 hours; for each additional 55 hours, students earn an additional half-credit. A maximum of three credits may be earned for the successful completion of a 330-hour course. The number of additional credits and the nature of the assignments to be completed must be established before the start of the course.

In all subjects included in the broad-based technology program, the courses developed by schools must cover a range of areas and applications within the subject. In manufacturing technology and technological design, the courses outlined in this document allow for the treatment of a wide variety of subject areas and applications. In communications technology, construction technology, health and personal services, and transportation technology, the areas that must be addressed in every course are specified in the course descriptions and subject overviews given in this document. For example, it is expected that students taking a course in transportation technology will study land, air, and marine transportation, and that students taking a course in communications technology will learn about electronic, live, recorded, and graphic communications. In any broad-based technology subject, courses may be developed to emphasize a particular area (e.g., land transportation in transportation technology), but not to the exclusion of other areas within the subject. *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.* Some schools may wish to offer more than one course developed from a course outlined in this document, each emphasizing a different area of the subject. In such cases, students may earn credit for the successful completion of only one of the courses offered.

In courses that emphasize a particular area or that exceed 110 hours of scheduled instructional time to allow students to prepare for certification, apprenticeship programs, or school-work transition programs, the content and the skills and processes related to the area of emphasis and/or the additional practice should reflect current industry practices and standards.

The principal of a school will retain on file up-to-date copies of the outlines of all courses of study for courses offered at the school. Each outline of a course of study will include the overall expectations for the course identified in this document; an outline of the course content based on the specific expectations, including unit titles listed in the sequence in which the material will be studied; and all of the other items specified in section 7.1.1 of *Ontario Secondary Schools, Grades 9 to 12: Program and Diploma Requirements, 1999*.

All technological education courses must be identified by the five-character course code given in this document (e.g., TTJ3C for Transportation Technology, Grade 11, College Preparation). Schools may add a sixth character to the code to indicate additional information. For example, if a school offers both a one-credit and a three-credit Grade 11 college preparation course in transportation technology that emphasizes land transportation, TTJ3C**1** could be used to identify the course worth one credit, and TTJ3C**2** could be used to identify the course worth three credits. If the school also offers one-credit and three-credit courses emphasizing air transportation, the code TTJ3C**3** could be used to identify the course worth one credit, and TTJ3C**4** could be used to identify the course worth three credits. In school calendars, the area of emphasis of a course may be identified by adding a descriptive word or phrase to the course title and an additional sentence to the course description provided in this document.

If a school or board identifies a need among students and/or the community for a course that is not represented among the courses outlined in this curriculum policy document, the school or board may wish to apply to the ministry to offer a locally developed course. Information on locally developed courses can be found on the ministry's website, at http://www.edu.gov.on.ca.

Courses in Technological Education, Grades 11 and 12

Part A: Broad-Based Technology

Grade	Course Name	Course Type	Course Code	Prerequisite
Communications Technology				
11	Communications Technology	University/College	TGJ3M	None
11	Communications Technology	Workplace	TGJ3E	None
12	Communications Technology	University/College	TGJ4M	Grade 11 Communications Technology, University/College
12	Communications Technology	Workplace	TGJ4E	Grade 11 Communications Technology, Workplace
Construction Technology				
11	Construction Technology	College	TCJ3C	None
11	Construction Technology	Workplace	TCJ3E	None
12	Construction Technology	College	TCJ4C	Grade 11 Construction Technology, College
12	Construction Technology	Workplace	TCJ4E	Grade 11 Construction Technology, Workplace
Health and Personal Services				
11	Health Care	College	TPA3C	None
11	Hairstyling and Aesthetics	Workplace	TPE3E	None
12	Child Development and Gerontology	College	TPO4C	None
12	Medical Technologies	College	TPT4C	Grade 11 Health Care, College
12	Hairstyling and Aesthetics	Workplace	TPE4E	Grade 11 Hairstyling and Aesthetics, Workplace
Hospitality and Tourism				
11	Hospitality	College	TFT3C	None
11	Hospitality and Tourism	Workplace	TFH3E	None
12	Tourism	College	TFS4C	None
12	Hospitality and Tourism	Workplace	TFH4E	Grade 11 Hospitality and Tourism, Workplace
Manufacturing Technology				
11	Manufacturing Engineering Technology	College	TMJ3C	None
11	Manufacturing Technology	Workplace	TMJ3E	None
12	Manufacturing Engineering Technology	College	TMJ4C	Grade 11 Manufacturing Engineering Technology, College
12	Manufacturing Technology	Workplace	TMJ4E	Grade 11 Manufacturing Technology, Workplace

Grade	Course Name	Course Type	Course Code	Prerequisite
Technological Design				
11	Technological Design	University/College	TDJ3M	None
11	Technological Design	Workplace	TDJ3E	None
12	Technological Design	University/College	TDJ4M	Grade 11 Technological Design, University/College
12	Technological Design	Workplace	TDJ4E	Grade 11 Technological Design, Workplace
Transportation Technology				
11	Transportation Technology	College	TTJ3C	None
11	Transportation Technology	Workplace	TTJ3E	None
12	Transportation Technology	College	TTJ4C	Grade 11 Transportation Technology, College
12	Transportation Technology	Workplace	TTJ4E	Grade 11 Transportation Technology, Workplace

Part B: Computer Studies

Grade	Course Name	Course Type	Course Code	Prerequisite
Computer and Information Science				
11	Computer and Information Science	University/College	ICS3M	None
12	Computer and Information Science	University/College	ICS4M	Grade 11 Computer and Information Science, University/College
Computer Engineering				
11	Computer Engineering	University/College	ICE3M	None
11	Computer Engineering	Workplace	ICE3E	None
12	Computer Engineering	University/College	ICE4M	Grade 11 Computer Engineering, University/College, or Grade 11 Computer and Information Science, University/College
12	Computer Engineering	Workplace	ICE4E	Grade 11 Computer Engineering, Workplace

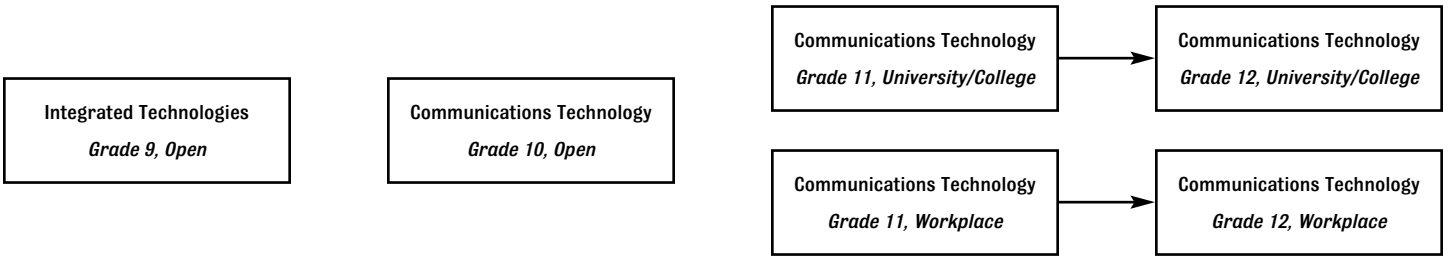
Note: When scheduled for 110 hours of instructional time, each of the courses listed above is worth one credit.

Prerequisite Charts for Technological Education, Grades 9–12

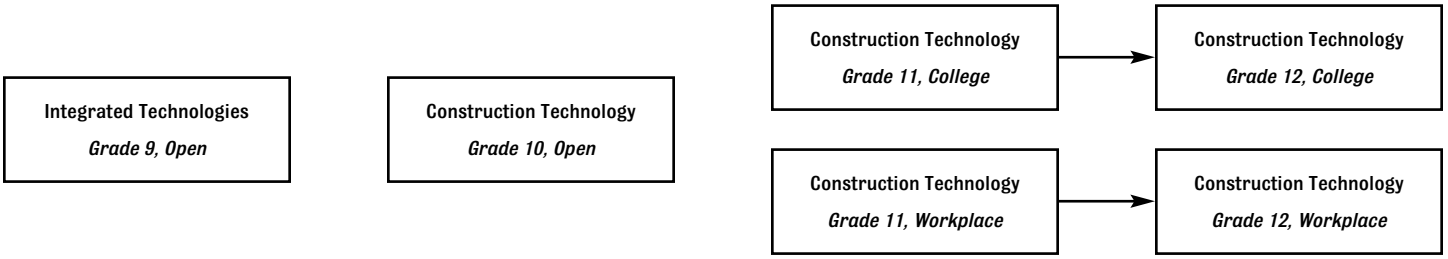
Part A: Broad-Based Technology

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.

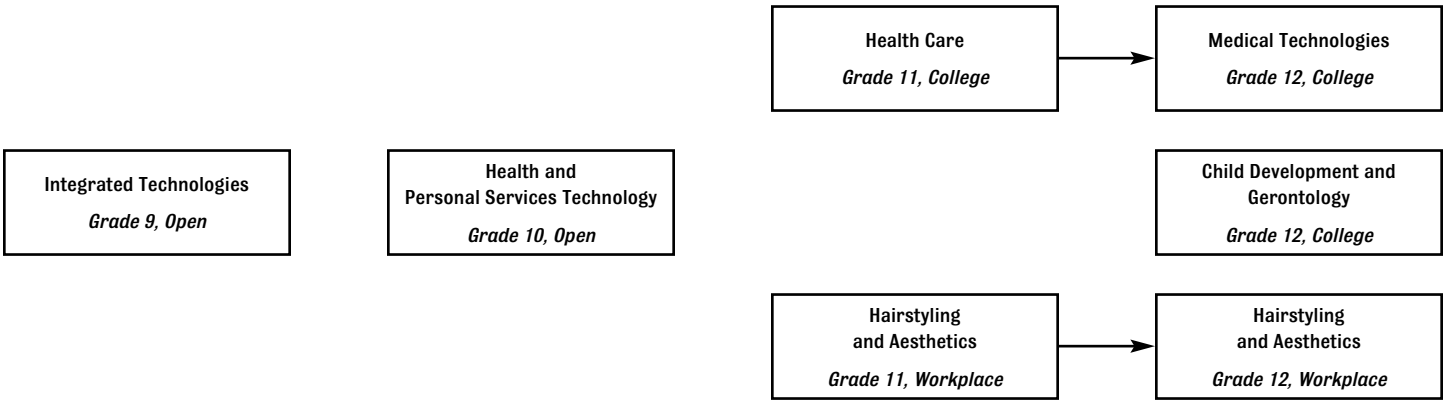
Communications Technology



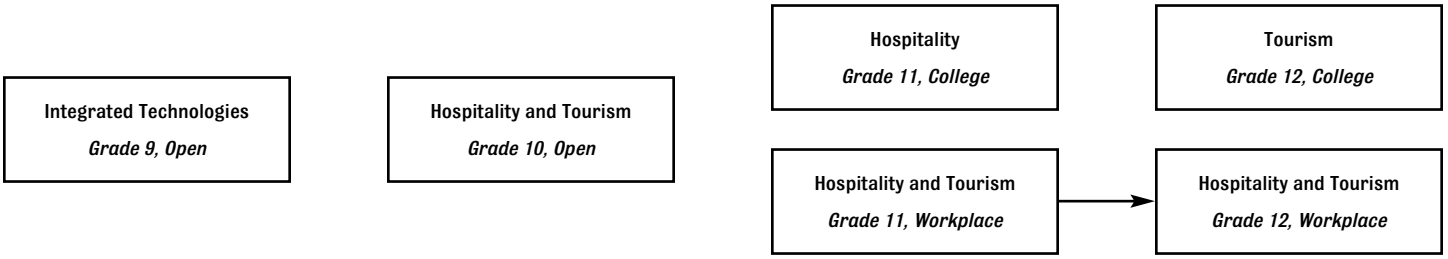
Construction Technology



Health and Personal Services

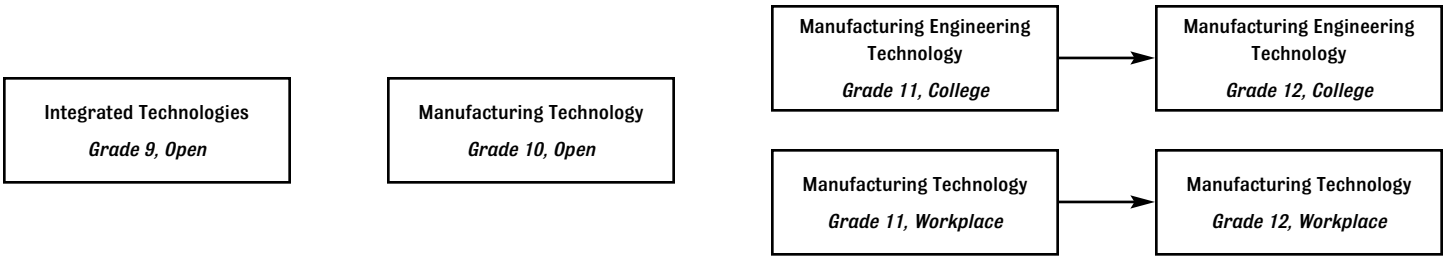


Hospitality and Tourism

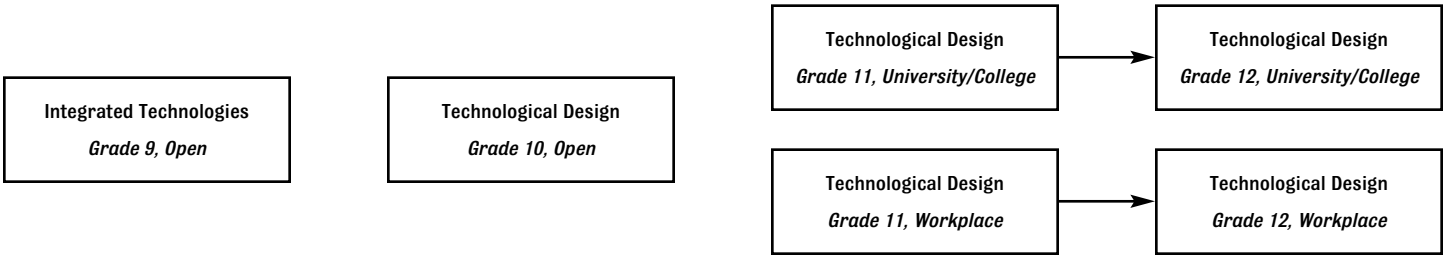


Part A: Broad-Based Technology (cont.)

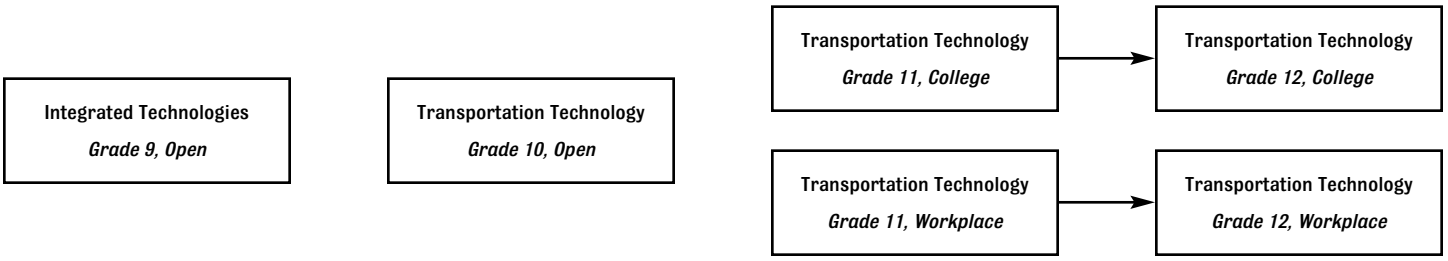
Manufacturing Technology



Technological Design



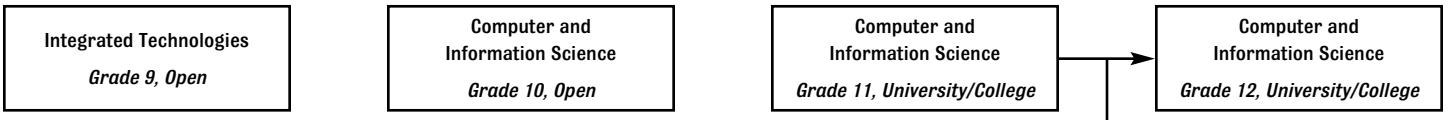
Transportation Technology



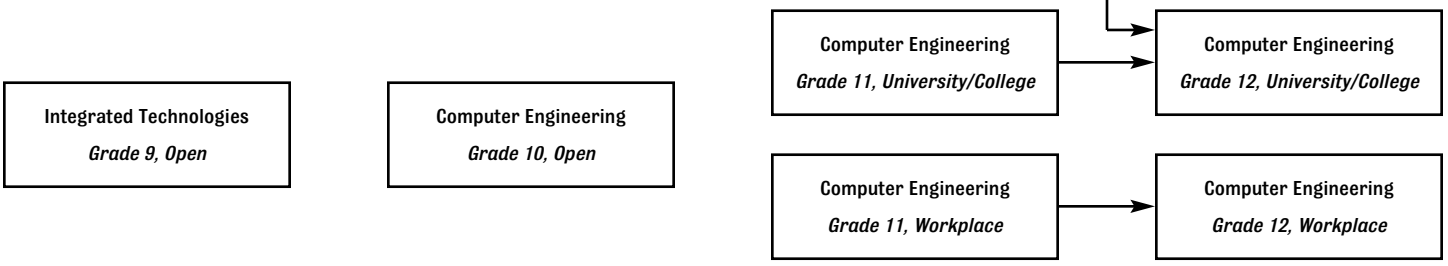
Part B: Computer Studies

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.

Computer and Information Science



Computer Engineering



Teaching Approaches

Technological education involves knowing, doing, testing, designing and building, and evaluating. Teaching and learning approaches should address all of these areas. Students should use projects as a major means of achieving these expectations, and they should be provided with a combination of information and experience 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 will be involved in:

– investigating technological products, systems, and processes;
– gaining knowledge of the principles and processes of technology;
– exploring needs that can be met through technology;
– creating and evaluating alternatives and modifications in relation to these needs;
– developing safe and efficient work habits;
– making products that satisfy defined specifications and standards of quality and safety;
– making connections between technology and society (past, present, and future);
– assessing related career opportunities and requirements;
– developing confidence to contribute to a technological society.

It is important that students have opportunities to learn in a variety of ways. 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.

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.

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 *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 in some courses are organized under subheadings that reflect particular aspects of the required knowledge and skills and that may serve as a guide for teachers as they plan learning activities for their students. The organization of expectations in 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.

Many of the expectations are accompanied by examples, given in parentheses. These examples are meant to illustrate the kind of skill, the specific area of learning, the depth of learning, and/or the level of complexity that the expectation entails. They are intended as a guide for teachers rather than as an exhaustive or mandatory list.

Strands

The overall and specific expectations for each course in the technological education program are organized in three distinct but related strands. While each strand is represented in all courses, not all parts of the definition of each strand may apply to all courses.

Theory and foundation. The key ideas about concepts, components and systems, materials, services, and products.

Skills and processes. The technological skills and processes required for responding to a variety of practical challenges.

Impact and consequences. Safety-related issues, career opportunities, and the implications of technology.

Part A. Broad-Based Technology

Communications Technology

Overview

Communications technology affects all aspects of our lives, from work to leisure. It extends our ability to communicate and is an important part of being technologically literate.

These courses will provide students with opportunities to acquire the knowledge and skills required to design, use, and manage electronic, live, recorded, and graphic communications systems. They will help students understand the role of communications technology in our economy; its relationship with other economic sectors; and its effect on people, society, and the environment. Students will also examine standards and regulations, health and safety issues, careers, and the importance of lifelong learning.

For essential information on policy regarding multiple-credit courses and courses with particular areas of emphasis, see pages 6-7 of this document.

Communications Technology, Grade 11, University/College Preparation (TGJ3M)

This course examines communications systems and design and production processes in the areas of electronic, live, recorded, and graphic communications. Students will develop knowledge and skills relating to the assembly, operation, maintenance, and repair of the basic and more complex components of a range of communications systems. Students will also study industry standards and regulations and health and safety issues, and will explore careers, the importance of lifelong learning, and the impact of communications technology on society and the environment.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services in response to challenges or problems in electronic, live, recorded, or graphic communications;
- identify and describe the components and processes that make up each of the following: electronic, live, recorded, and graphic communications;
- explain how basic communications systems function and describe the knowledge required to manage a range of communications systems;
- describe industry standards, regulations, and formats that apply to communications technology.

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how a human need or want can be met through a new or improved product;

– apply the following steps of the design process to solve a variety of communications technology challenges or problems:

□ identify what has to be accomplished (the problem);

□ gather and record information, and establish a plan of procedures;

□ brainstorm a list of as many solutions as possible;

□ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;

□ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;

□ produce a drawing, model, or prototype of the best solution;

□ evaluate the prototype and what is required to produce it;

□ communicate the solution, using one or more of the following: final drawings, technical reports, electronic presentations, flow charts, storyboards, mock-ups, prototypes, and so on;

□ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Components, Systems, and Processes

By the end of this course, students will:

– explain the basic electronic communications system (how energy is converted into an electrical signal, amplified, transmitted by physical or atmospheric channels, decoded, and converted to sound);

– describe the processes of analog-digital and digital-analog signal conversion;

– explain how electricity and magnetism form the basis for audio and video communications;

– demonstrate a working knowledge of amplification and signal processing;

– identify the advantages of various formats for specific applications;

– summarize the configurations for a variety of electronic, live, recorded, and graphic systems, and develop a plan to set up and manage the systems;
– evaluate component properties and select the most appropriate components for a particular process.

Standards

By the end of this course, students will:

– outline guidelines, conventions, and rules used in the composition and design of a communications process;
– research appropriate production techniques and recommend processes that adhere to industry standards;
– select the appropriate formats for electronic, live, recorded, and graphic productions.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- effectively plan, organize, direct, and control a variety of communications activities;
- use current technology and production skills to develop a process or a product in response to a communications challenge or problem;
- set up, operate, and maintain a communications system and analyse its efficiency;
- use effective techniques to carry out and document the steps in pre-production, production, and post-production;
- use mathematical and language skills effectively and apply scientific principles in the design of electronic, live, recorded, and graphic communications systems.

Specific Expectations

Organizational Skills

By the end of this course, students will:

– demonstrate the interpersonal skills required for effective teamwork;

– function effectively as individuals and as members of a cooperative team to produce a product or service;

– demonstrate the time management and problem-solving skills required to complete projects;

– accurately document planning and production processes;

– effectively apply a variety of planning tools (e.g., storyboards, flow charts, schematic diagrams);

– select and use appropriate software to manage the production process;

– use time management schemes to ensure that their productions meet client deadlines.

Production Skills

By the end of this course, students will:

– set up and correctly operate the equipment and accessories required to create and modify environments for communications productions (e.g., video and audio editing suites, desktop publishing configurations, live and recorded productions, electronic communication systems, websites);

– select and use tools and equipment to solve a communications problem;

– operate control devices and components to manipulate or create communications technology projects;

– develop and interpret technical and artistic drawings, reports, instructions, manuals, on-line documentation, and specifications to help solve a communications problem;

– set up and operate communications equipment (e.g., transmitters and receivers, frequency and phase modulation equipment, antennas, two-way communications equipment);

– troubleshoot a communications system to remove any obstacles to its effective operation;
– design and set up a communications system (e.g., a computer network, audio and video editing systems, lighting grids) to perform production and post-production processes.

Documentation and Standards

By the end of this course, students will:

– use a variety of methods to document the planning and production processes;
– use specific gauges and meters to monitor, test, and modify processes or systems to ensure adherence to industry-recognized standards;
– use industry-standard guidelines, conventions, and rules for composition and design;
– use colour theory and colour standards to create presentations that adhere to industry standards.

Interdisciplinary Applications

By the end of this course, students will:

– apply mathematics accurately in spreadsheets and when calculating electrical current, resistance, and energy consumption;
– use appropriate language in flow charts, storyboards, operation charts, scripts, and presentations;
– use terminology that is recognized by the communications industry;
– apply scientific principles related to light, magnetism, and basic digital fundamentals.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe the social, environmental, and economic impacts of communications technology;
- demonstrate an understanding of the health and safety rules and regulations applicable to a communications technology program;
- identify career opportunities in the communications technology sector and the skills, education, and training required for each.

Specific Expectations

Impacts

By the end of this course, students will:

– describe social, environmental, and economic influences that affect the evolution of the communications industry;

– explain how communications technology has contributed to globalization and has influenced economic and social issues;

– describe how communications technology plays a vital role in the production, promotion, and maintenance of different products.

Safety and Legislation

By the end of this course, students will:

– apply safe work practices when performing communications processes;

– identify potential hazards in their workplace by conducting safety audits and inspections;

– describe specific components of the Occupational Health and Safety Act that relate to their workplace and the actions required on their part to adhere to them;

– describe the Workplace Hazardous Materials Information System (WHMIS) and explain the importance of consulting material safety data sheets (MSDS) whenever appropriate.

Education, Training, and Career Opportunities

By the end of this course, students will:

– explore communications programs offered by postsecondary institutions;

– describe the personal attributes required for careers in the creative, management, and skilled trade areas of the communications sector;

– distinguish among the careers of technician, technologist, and engineer and identify the education required for each;

– describe the roles of unions, guilds, and associations in the communications sector;

– explain the importance of lifelong learning for individuals in the communications technology sector.

Communications Technology, Grade 11, Workplace Preparation (TGJ3E)

This course examines communications systems and design and production processes in the areas of electronic, live, recorded, and graphic communications. Students will be given the opportunity to develop and apply practical skills to assemble, repair, operate, maintain, and test various systems. Students will also study industry standards and regulations and health and safety issues, and will explore careers, the importance of lifelong learning, and the impact of communications technology on society and the environment.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services in response to simple challenges or problems in electronic, live, recorded, or graphic communications;
- identify the mechanical and electronic characteristics of the components and processes required to produce a product or a service in communications technology;
- demonstrate an understanding of electronic, live, recorded, and graphic communications systems;
- describe industry standards applicable to communications technology.

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how a human need or want can be met through a new or improved product;

– apply the following steps of the design process to solve a variety of simple communications technology challenges or problems:

□ identify what has to be accomplished (the problem);
□ gather and record information, and establish a plan of procedures;
□ brainstorm a list of as many solutions as possible;
□ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
□ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;
□ produce a drawing, model, or prototype of the best solution;
□ evaluate the prototype and what is required to produce it;
□ communicate the solution, using one or more of the following: final drawings, technical reports, electronic presentations, flow charts, storyboards, mock-ups, prototypes, and so on;
□ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Components, Systems, and Processes

By the end of this course, students will:

– explain the processes and components (e.g., photography, desktop publishing, printing, web-page creation) used in current communications technology;

– explain different methods of storing and retrieving information and the advantages of each;

– explain how digitization is used for print, audio, video, recording, and photographic media and in the transfer of data;

– explain how microchip advancements have affected the development of computers and other electronic devices;

– explain how signals are transmitted via wire, cable, fibre optic filaments, electromagnetic waves, and satellites;

– explain fundamental digital concepts and the functions of basic equipment, including analog and digital signals, logic gates and circuits, counters and readout devices, and peripheral communications devices that interface with computers;
– explain the relationship among current, voltage, and resistance;
– define the following terms: watt, kilowatt, amp, volt, direct current, alternating current, parallel circuit, series circuit;
– explain how different materials and components are converted or assembled to make finished products.
– analyse and describe the electronic components of an industry-standard communications system;
– explain how the concepts of encoding, storing, decoding, transmitting, and receiving apply to electronic, live, recorded, and graphic projects in communications technology;
– explain how electricity and magnetism form the basis for audio and video communications;
– describe the effects of frequency and phase modulation in a communications system;
– explain the purpose of transmitters, receivers, and antennas in a communications technology system.

Standards

By the end of this course, students will:

– define the terminology used in the areas of electronic, live, recorded, and graphic communications;
– recognize symbols used for identification in current electronic, live, recorded, and graphic communications systems;
– identify industry regulations that affect systems and components in electronic, live, recorded, and graphic communications.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- function effectively as individuals and as members of a cooperative team to produce a product or service;
- produce, assemble, connect, and operate current equipment and components to perform specific functions related to communications technology;
- use appropriate equipment and techniques to communicate, describe, and market solutions to communications technology problems;
- use mathematical and language skills effectively and apply scientific principles to construct products that adhere to design specifications.

Specific Expectations

Organizational Skills

By the end of this course, students will:

– demonstrate the interpersonal skills required for effective teamwork;

– develop the time management and problem-solving skills required to complete projects;

– accurately document planning and production processes;

– effectively apply a variety of planning tools (e.g., storyboards, flow charts, schematic diagrams);

– select and use appropriate software to manage the production process;

– use time management schemes to ensure that their productions meet client deadlines.

Production Skills

By the end of this course, students will:

– use appropriate techniques to model and communicate project ideas, materials, and specifications;

– demonstrate the skills required to complete communications technology projects, both independently and in a group;

– use a variety of communications equipment and processes to produce pictorial and technical drawings, models, and prototypes of a communications product or a service;

– produce, repair, use, and maintain components and systems;

– demonstrate troubleshooting and testing skills using measurement and quality control instruments;

– follow assembly and prescribed maintenance procedures for components or systems in communications technology.

Documentation and Standards

By the end of this course, students will:

– use a variety of methods to document the planning and production processes;

– use specific gauges and meters to monitor, test, and modify processes or systems to ensure adherence to industry-recognized standards;

– use industry-standard guidelines, conventions, and rules for composition and design;

– use colour theory and colour standards to create presentations that adhere to industry standards.

Interdisciplinary Applications

By the end of this course, students will:

– apply mathematical equations to solve simple problems (e.g., calculating current loads and resistance, file sizes for bitmaps, or frame rates for animation);

– use appropriate language in reports and presentations;

– apply scientific principles related to concepts such as light, magnetism, and colour.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe the social, environmental, and economic impacts of communications technology;
- identify pertinent legislation and practices related to safety in a communications technology facility and in the workplace;
- describe the career opportunities available in the communications technology sector immediately on graduation from high school;
- identify the employability skills required to be successful in the workplace.

Specific Expectations

Impacts

By the end of this course, students will:

– describe the social, environmental, and economic effects of technological advancements in the communications sector.

Safety and Legislation

By the end of this course, students will:

– identify hazards related to materials, processes, and equipment in a communications technology work environment;

– describe health and safety precautions for students and workers in a communications technology environment, and apply where appropriate;

– explain the need for health and safety laws and regulations related to a communications technology environment;

– explain how to handle hazardous materials in accordance with the Workplace Hazardous Materials Information System (WHMIS) guidelines.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify career opportunities in the communications sector;

– describe the prerequisites for employment in communications sector careers and assess their own aptitude for such careers;

– identify the employability skills that employers seek in potential employees;

– explain the importance of lifelong learning for individuals in the communications technology sector.

Communications Technology, Grade 12, University/College Preparation (TGJ4M)

This course examines communications systems and design and production processes in the areas of electronic, live, recorded, and graphic communications. Students will create, manage, and distribute complex electronic, graphic, recorded, or audio-visual projects independently and in project teams. Students will also study industry standards and regulations and health and safety issues, and will explore careers, the importance of lifelong learning, and the impact of communications technology on society and the environment.

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

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services in response to complex challenges or problems in electronic, live, recorded, or graphic communications;
- describe the processes used to plan an independent project in communications technology;
- explain how to maximize the performance of electronic, live, recorded, or graphic communications systems;
- describe the different industry standards that apply to electronic, live, recorded, or graphic communications;
- describe the different forms of current communications systems and how they interface with one another.

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how a human need or want can be met through a new or improved product;

– apply the following steps of the design process to solve a variety of complex communications technology challenges or problems:

□ identify what has to be accomplished (the problem);

□ gather and record information, and establish a plan of procedures;

□ brainstorm a list of as many solutions as possible;

□ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;

□ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;

□ produce a drawing, model, or prototype of the best solution;

□ evaluate the prototype and what is required to produce it;

□ communicate the solution, using one or more of the following: final drawings, technical reports, electronic presentations, flow charts, storyboards, mock-ups, prototypes, and so on;

□ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Components, Systems, and Processes

By the end of this course, students will:

– analyse colour theory and industry standards for colour manipulation and representation;

– demonstrate a working knowledge of signal conversion, amplification, and processing;

– research and describe the equipment and techniques used in the communications industry and in postsecondary programs;

– describe the roles of individuals within a communications system or process;

– describe the use of state-of-the-art technology (e.g., microwaves; fibre optics; wireless, streamed netcasting, digital audio, and infrared communications systems).

Standards

By the end of this course, students will:

– identify the purpose of industry formats in electronic, live, recorded, or graphic communications systems;

– describe the current guidelines, conventions, and rules used in communications design and production.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- design and plan solutions to problems both individually and as members of a team;
- select and safely use the appropriate technologies and resources to solve problems in electronic, live, recorded, or graphic communications technology;
- organize and maintain complex communications systems;
- use industry-recognized standards and formats when developing and recording solutions to problems;
- use mathematics and language skills and apply scientific principles to design and set up communications systems and production processes for electronic, live, recorded, or graphic communications projects.

Specific Expectations

Organizational Skills

By the end of this course, students will:

– analyse and demonstrate the interpersonal and group skills required to work as part of a team;

– develop a production plan for a project from its conception to its completion;

– apply time management skills, including the use of software scheduling and project management software, to meet deadlines when solving problems.

Production Skills

By the end of this course, students will:

– operate and control devices effectively in communications technology projects;

– use industry standard specific gauges and meters to monitor, test, and modify project requirements;

– integrate various current communications technologies in their solutions;

– select appropriate computer software and production techniques to complete projects;

– connect digital and analog systems to process signals;

– troubleshoot components of communications systems;

– set up and operate the components and systems required to create and modify environments for communications productions (e.g., a live production studio, desktop publishing configurations, websites, test labs).

Documentation and Standards

By the end of this course, students will:

– develop a personal portfolio to use to document skills in communications technology;

– use software programs to document the project planning and production process;

– use appropriate graphics formats in preproduction documents and drawings.

Interdisciplinary Applications

By the end of this course, students will:

– select appropriate formulas to solve mathematical problems in production and post-production work (e.g., calculating resistance related to wire size when transmitting signals);

– develop the technical vocabulary used in electronic, live, recorded, or graphic communications;

– apply scientific principles related to light, colour, magnetism, and electricity.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- demonstrate an ability to make informed decisions related to the social, environmental, and economic consequences and impacts of the communications technology sector;
- implement safe work practices when performing communications technology tasks;
- identify the role of health and safety legislation in schools and in the communications sector;
- describe postsecondary programs associated with the communications technology sector and evaluate the appropriateness of the programs to their career plans.

Specific Expectations

Impacts

By the end of this course, students will:

– identify potential consequences of specific communications technology activities for the individual and for society, and formulate potential alternatives to minimize harmful consequences (e.g., by assessing the effect of innovations in the transmission and reception of long-distance communications signals);

– describe the negative impacts of communications technology activities on the environment and identify a variety of materials, processes, and waste management methods to reduce them;

– explain the economic impact of the communications technology sector for the local community, the province, and the nation.

Safety and Legislation

By the end of this course, students will:

– use safe work practices and model the most appropriate ways of accomplishing specific operations;

– develop and conduct safety audits and inspections of the school communications technology facility and implement a plan to address any deficiencies;

– develop an effective emergency action plan for the school communications technology facility;

– analyse the Occupational Health and Safety Act (OHSA) and implement the parts of it that relate specifically to the school communications technology facility;

– identify the issues addressed in the Workplace Hazardous Materials Information System (WHMIS).

Education, Training, and Career Opportunities

By the end of this course, students will:

– demonstrate a knowledge of career activities within the communications technology sector, including those in creative occupations, management positions, and skilled trades;

– demonstrate an understanding of their own strengths and limitations in preparation for careers in the communications technology sector;

– investigate the opportunities for self-employment in the communications sector and the education and skills that would be required;

– complete electronic portfolios that include their career and education plans;

– identify the entry requirements to guilds and associations in the communications technology sector.

Communications Technology, Grade 12, Workplace Preparation (TGJ4E)

This course examines the key elements in the areas of electronic, live, recorded, or graphic communications systems. Students will develop safe workplace habits and business management skills and use a variety of materials, tools, and equipment to assemble, maintain, operate, and repair communications systems. They will also research the entry requirements for training programs available on graduation, such as apprenticeships, and will develop the employability and technical skills required for entry into the workplace.

Prerequisite: Communications Technology, Grade 11, Workplace Preparation

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services in response to challenges or problems in electronic, live, recorded, or graphic communications;
- identify the processes, concepts, materials, and components used in the development of a product or service;
- analyse and describe the effects of modifications on communications systems;
- demonstrate an in-depth understanding of industry standards and regulations related to electronic, live, recorded, or graphic communications technology.

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how a human need or want can be met through a new or improved product;

– apply the following steps of the design process to solve a variety of communications technology challenges or problems:

□ identify what has to be accomplished (the problem);

□ gather and record information, and establish a plan of procedures;

□ brainstorm a list of as many solutions as possible;

□ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;

□ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;

□ produce a drawing, model, or prototype of the best solution;

□ evaluate the prototype and what is required to produce it;

□ communicate the solution, using one or more of the following: final drawings, technical reports, electronic presentations, flow charts, storyboards, mock-ups, prototypes, and so on;

□ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Components, Systems, and Processes

By the end of this course, students will:

– identify and describe current processes, methods of operation, materials, equipment, tools (including computers and peripherals), and components used to meet client needs;

– identify and describe necessary resources and scheduling requirements for the phases of production, including pre-production and post-production;

– demonstrate an understanding of industry-standard electronic, live, recorded, or graphic communications systems;

– explain how microwaves, lasers, and fibre optics are used in communications systems.

Standards

By the end of this course, students will:

– define the terminology and symbols used in the areas of electronic, live, recorded, or graphic communications;

– explain the conventions, formats, and specifications of industry-standard communications systems.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- work as an effective member of a team;
- set up, and function well in, an effective communications technology enterprise;
- use current technology and a variety of communications-related processes to create products that meet specifications determined by a client's needs;
- develop and maintain systems that adhere to industry standards, and develop the means required to document activities using industry-standard formats;
- use language skills and artistic concepts effectively and apply scientific principles to develop solutions to communications problems.

Specific Expectations

Organizational Skills

By the end of this course, students will:

– explain the activities associated with research and development: discovering a need, developing a product, and establishing specifications for improvement;

– describe the activities associated with marketing: identifying the potential market, promoting the product, selling and distributing the product;

– explain the activities associated with industrial relations: recruiting, selecting, and training the work force;

– describe how a company conducts its financial affairs (how it raises and controls its money);

– demonstrate communication, conflict resolution, time management, and goal-setting skills, as well as the ability to accept responsibility and to delegate tasks when appropriate;

– plan with team members to establish the order of operations; the availability of tools, parts, and equipment; scheduling requirements; and other information required to plan and prepare for the production process;

– document the production process using industry-standard formats (e.g., storyboards, schematics, flow charts);

– prepare a business plan for a venture related to communications technology.

Production Skills

By the end of this course, students will:

– set up and maintain a current electronic, live, recorded, or graphic communications system;

– troubleshoot and repair communications systems;

– identify, select, and use the most appropriate equipment and processes when developing a solution to a communications problem;

– design and produce a variety of communications projects that meet the demands of specific customers or markets;

– apply design principles and elements to produce effective solutions in communications technology projects;

– apply current production skills safely and effectively in the development of a product or service;

– prepare documents for communications projects, including cost estimates and bidding procedures, lists of materials and labour costs, and work orders and specifications;
– prepare, interpret, and follow work-related processes when maintaining communication components and systems;
– solve practical production problems in a variety of simulated workplace situations.

Documentation and Standards

By the end of this course, students will:

– produce, read, and interpret technical and artistic drawings, reports, instructions, scripts, manuals, on-line documentation, and specifications related to complex communications technology projects;
– document and communicate the results of the design process, of diagnostic analysis, and of troubleshooting for various communications technology projects.

Interdisciplinary Applications

By the end of this course, students will:

– use language effectively in presentations related to communications projects;
– apply artistic and aesthetic principles to designs related to communications projects;
– apply appropriate scientific principles (e.g., those related to light, colour, magnetism, electricity) in the design and production of communications technology systems.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- evaluate negative environmental impacts of specific products and processes and recommend alternative methods and materials to reduce these impacts;
- develop and conduct safety audits and inspections of the school communications technology facility and implement a plan to address any deficiencies;
- describe the Occupational Health and Safety Act (OHSA) and identify its implications for the school communications facility and for the workplace;
- identify the career opportunities and apprenticeships or other training programs available in the communications sector, and assess their aptitude for such opportunities;
- describe the entrepreneurial and management roles in a business or operation incorporating communications technology and assess their own potential for such roles;
- demonstrate the employability skills required for success in the workplace.

Specific Expectations

Impacts

By the end of this course, students will:

– evaluate any negative impacts on the environment of processes used in communications technology and substitute environmentally friendly alternatives;

– recommend an effective process for collecting and recycling materials and fluids;

– handle waste products effectively and be prepared to implement an emergency action plan in the event of a minor spill.

Safety and Legislation

By the end of this course, students will:

– use safe work practices in the communications program;

– develop comprehensive safety checklists for equipment and operations;

– use all required protective clothing and gear, and assume ergonomically correct body positions and movements (e.g., when keyboarding);

– demonstrate good housekeeping practices in the work environment by cleaning up spills and leaks, keeping areas clean and clear of obstructions, and organizing equipment to minimize the chance of an accident;

– recognize and explain the electrical hazards present when using electrical equipment;

– recognize and explain the hazards of exposure to electromagnetic radiation;

– identify and adhere to those aspects of the Occupational Health and Safety Act (OHSA) and the Workplace Hazardous Materials Information System (WHMIS) that relate to procedures and operations used in the school communications technology facility.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify the career opportunities available in the communications sector;

– identify the training required for careers in the communications sector;

– describe the employability skills identified by the Conference Board of Canada.

Construction Technology

Overview

Whether residential, commercial, industrial, or recreational, construction has always played a central role in human life. Through construction courses that incorporate learning opportunities outside school, students will learn about the tools, equipment, and processes required to design, construct, and maintain a variety of buildings and structures. They will also learn about the construction industry's health and safety standards, building codes and regulations, and employment opportunities and careers in the various sectors of the industry. Note that a construction project may result in a product, system, process, or service. It may also involve production, repair, or maintenance.

The Grade 11 construction courses focus on residential and light construction systems related to commercial, industrial, and/or recreational buildings and structures. The Grade 12 courses focus on advanced residential and more complex construction, as well as the introduction of heavy construction systems, related to commercial, industrial, and/or recreational buildings and structures.

Links and partnerships with construction associations, home builders associations, and local business and industry should be established to provide students with opportunities to learn about careers in the construction industry.

For essential information on policy regarding multiple-credit courses and courses with particular areas of emphasis, see pages 6-7 of this document.

Note: Working with wood as a material, other than in building construction, is included under manufacturing technology or technological design.

Construction Technology, Grade 11, College Preparation (TCJ3C)

This course focuses on residential and light construction systems related to commercial, industrial, and/or recreational construction. Students will learn about the tools, materials, equipment, and methods used in the light construction industry; structural analysis and design; presentation and working drawings; and auxiliary systems. They will also estimate materials and labour costs; study industry standards and building codes; consider health and safety issues and energy conservation; and explore careers and the impact of construction technology on society and the environment.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services in response to challenges or problems in construction technology;
- explain different techniques used to visualize, describe, present, and build final products of designs of buildings and other structures (e.g., presentation and working drawings);
- describe the properties of natural and manufactured building materials, processes, and finishes;
- identify the building codes, regulations, and standards governing a construction project;
- describe appropriate building construction techniques; construction systems (electrical, mechanical, structural); and the building materials, tools, and equipment used in the construction industry.

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how a human need or want can be met through a new or improved product;

– apply the following steps of the design process to solve a variety of construction technology challenges or problems:
  □ identify what has to be accomplished (the problem);
  □ gather and record information, and establish a plan of procedures;
  □ brainstorm a list of as many solutions as possible;
  □ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
  □ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;
  □ produce presentation and working drawings, sketches, graphics, mathematical and physical models, or a prototype of the best solution;
  □ evaluate the prototype and determine the resources, including computer applications, required to produce it;
  □ communicate the solution, using one or more of the following: final drawings, graphs, charts, sketches, technical reports, electronic presentations, flow charts, mock-ups, models, prototypes, and so on;
  □ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Building Materials and Methods

By the end of this course, students will:

– describe the properties (physical, mechanical, and thermal) of the natural and manufactured building products used in construction projects;

– describe the processes used to prepare natural and manufactured wood products for the construction industry;

– describe the various finishes and preservatives applied to wood products used in construction projects;

– describe the materials commonly used for the various components of a construction project (e.g., footings, foundations, floors, walls, roof systems, windows, doors, millwork, interior and exterior finishes, hardware);

– identify a variety of building materials, construction techniques, architectural styles and details, and engineering features used in different construction projects;
– identify and describe the building codes, regulations, and standards applicable to construction projects.

Electrical, Mechanical, and Structural Systems

By the end of this course, students will:

– describe the operating principles of basic electrical, plumbing, heating, ventilation, and air-conditioning systems used in construction projects;
– use appropriately the terminology, symbols, industry standards, codes, regulations, and conventions related to the electrical, mechanical, and structural systems of a construction project;
– describe the types of loads and structural support members for footings, foundations, floors, walls, roofs, framing systems, bearing walls, columns, beams, lintels, and other parts of the systems used in a wood-frame construction project.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- demonstrate an understanding of the design process skills by applying them to a variety of construction projects;
- interpret and use technical data, building codes, regulations and standards, and other resources correctly;
- demonstrate a general understanding of residential and light construction systems, as well as the appropriate technical skills for using the tools, equipment, and materials required to complete a construction project;
- describe various documents, bidding procedures, and preliminary estimating methods used in construction projects;
- explain the importance of such aspects of construction projects as architectural styles and features, quality design and workmanship, and efficient and functional planning.

Specific Expectations

Design, Planning, and Communication Skills

By the end of this course, students will:

– design using effective brainstorming techniques, plan, and implement the best solutions for a variety of construction projects;

– apply design principles to, and identify good planning characteristics of, construction projects;

– describe and use the basic elements of space planning for different areas of a building or structure;

– describe different architectural styles and features of a construction project;

– describe the characteristics of a quality product in terms of good design, choice and finish of materials, and workmanship;

– research, document, and use resources applicable to construction projects such as technical data, charts, tables, reports, zoning by-laws, and building codes, regulations, and standards;

– explain the purpose and content of presentation and working drawings used in the construction industry;

– describe and,where appropriate, use basic traditional and computer-assisted drafting practices used in construction projects;

– produce appropriate presentation drawings (including isometric and oblique drawings, scale models, and two- and three-dimensional computer-generated drawings) using a variety of techniques (e.g., pencil, ink, computer software);

– produce appropriate working drawings, including site plans, floor plans, elevations, sections, and details, using a variety of techniques and computer software for a range of construction projects;

– design the structural elements of a construction project and develop drawings describing them and the required materials;

– design the mechanical systems of a building project (including electrical, plumbing, heating, ventilation, and air-conditioning systems) in accordance with building codes, regulations, and standards.

Building and Materials Application Skills

By the end of this course, students will:

- evaluate a property with respect to important design considerations (e.g., orientation, site restrictions, public services, zoning restrictions, and building codes, regulations, and standards);
- describe the tools, equipment, and procedures required to properly locate and stake out a building on a property;
- identify the major features of a site plan;
- identify the major considerations (e.g., soil type, building type and use, weight of the building material) for the footings of a construction project;
- identify the major features included in a foundation plan;
- identify the components of a floor system and determine proper joist and subfloor sizes;
- identify structural members and explain methods of frame wall construction;
- describe types of basic roof designs used in construction projects;
- describe the components of a roof system and determine the correct sizes for ceiling joists, rafters, and sheathing;
- explain the advantages of trusses for use in construction projects;
- explain the importance of allowing for proper ventilation and moisture protection, as well as using flashing correctly, in construction projects;
- describe the advantages and disadvantages of different types of windows and doors used in construction projects;
- demonstrate an ability to design and, where appropriate, build a stairway for a construction project;
- demonstrate an ability to design and, where appropriate, build a fireplace for a construction project;
- use a variety of tools and equipment to complete a construction project;
- complete a construction project using a variety of methods and procedures for laying out, assembling, and joining.

Estimates, Specifications, and Contracts

By the end of this course, students will:

- explain what is involved in developing an estimate of building costs;
- prepare a materials list for a construction project;
- estimate accurately the cost of a construction project using the volume and area method;
- explain the purpose and organization of material and work specifications;
- identify specification guides for building materials and work related to construction projects;
- describe various types of contracts and bidding processes used in the construction industry.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- explain the impact of the construction industry on the economy, on society, and on the environment;
- describe, and apply where appropriate, health and safety legislation; general shop and site safety rules; and rules specific to the safe use of materials, tools, and equipment;
- identify careers in construction technology and the skills, education, and training each requires.

Specific Expectations

Economic, Social, and Environmental Impacts

By the end of this course, students will:

– explain how the construction industry is directly linked to the local economy;

– explain how to reduce negative environmental and social impacts through the choice of particular energy sources, materials, or processes for construction projects;

– explain the use of natural and manufactured construction materials and the short- and long-term impact of their use on the environment;

– evaluate different types of construction projects in terms of efficiency, community building needs, environmental impact, and local building codes, regulations, and standards.

Health and Safety

By the end of this course, students will:

– identify hazards related to the materials, processes, and equipment used in a construction work environment;

– demonstrate safe shop practices when using hand and power tools, materials, and equipment;

– describe the basic health and safety needs of workers on construction sites;

– explain the need for health and safety laws and regulations;

– identify safety codes, regulations, and standards applicable to construction projects and the workplace;

– explain how to handle hazardous materials in accordance with the Workplace Hazardous Materials Information Systems (WHMIS) guidelines.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify career opportunities in the various sectors of the construction industry;

– describe the education and training required for employment in construction-related careers;

– identify postsecondary programs in the construction industry and describe their admission requirements;

– explain the importance of lifelong learning for someone choosing a career in the construction field.

Construction Technology, Grade 11, Workplace Preparation (TCJ3E)

This course focuses on residential and light construction systems related to commercial, industrial, and/or recreational construction; the development of generic employment skills; and preparation for apprenticeship and training programs. Students will learn about and gain practical experience with various types of materials, processes, labour, tools, and equipment used in the construction industry; technical drawings; and auxiliary systems. They will also study industry standards and building codes; consider health and safety issues; and explore careers, the importance of lifelong learning, and the impact of construction technology on society and the environment.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services in response to challenges or problems in construction technology;
- describe the properties and application of building materials, and of construction techniques and processes;
- describe the different technologies, materials, tools, and equipment applicable to construction technology;
- identify building codes, regulations, and standards applicable to construction, including those for electrical, mechanical, and structural systems.

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how a human need or want can be met through a new or improved product;

– apply the following steps of the design process to solve a variety of construction technology challenges or problems:
  □ identify what has to be accomplished (the problem);
  □ gather and record information, and establish a plan of procedures;
  □ brainstorm a list of as many solutions as possible;
  □ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
  □ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;
  □ produce presentation and working drawings, sketches, graphics, mathematical and physical models, or a prototype of the best solution;
  □ evaluate the prototype and determine the resources, including computer applications, required to produce it;
  □ communicate the solution, using one or more of the following: final drawings, graphs, charts, sketches, technical reports, electronic presentations, flow charts, mock-ups, models, prototypes, and so on;
  □ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Building Materials and Methods

By the end of this course, students will:

– describe the properties (physical, structural, and thermal) of both natural and manufactured building materials, and describe the processes used to produce or modify them;

– describe the materials used, and methods of applying them, for the various components of a construction project (e.g., footings, foundations, floors, walls, roofs, windows, doors, millwork, interior and exterior finishes, hardware);

– identify the building codes, regulations, and standards applicable to a construction project;

– describe the strength of a variety of species of wood, and of wood products, used in construction.

Electrical, Mechanical, and Structural Systems

By the end of this course, students will:

- describe the various systems applicable to the construction industry, including electrical, plumbing, heating, ventilation, and air-conditioning systems;
- identify the requirements for the various systems used in different construction projects, using technical resources such as charts, tables, and building codes, regulations, and standards;
- identify the structural elements (including materials, spans, loads, forces, and methods of assembly) of a construction project;
- identify materials with different structural properties used for different parts of construction projects (e.g., for footings, bearing walls, columns, beams and lintels, floor systems, ceiling and roof systems);
- identify the size of structural members required for a variety of projects, using technical resources such as charts, tables, and building codes, regulations, and standards.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- apply the design process to a variety of construction projects;
- demonstrate an ability to use resources such as technical data, reports, charts, tables, and building codes, regulations, and standards;
- demonstrate a general understanding of construction systems in terms of loads and stresses, structural members (shape, size, and placement), and the strength of the materials used for the foundation, floor, wall-framing, and roof systems found in residential and light construction projects;
- demonstrate appropriate technical skills involving the use of construction tools, materials, and equipment;
- apply mathematical and estimation skills in a variety of construction projects.

Specific Expectations

Design, Planning, and Communication Skills

By the end of this course, students will:

– design, plan, and implement solutions for a variety of construction projects;

– use both conventional and computer-aided methods to produce working drawings (e.g., site plans, floor plans, assembly drawings) – including elevations, sections, and details – for construction projects;

– research and gather requisite information, using electronic and traditional methods, for a variety of construction projects;

– evaluate and document construction projects in relation to predetermined criteria, specifications, needs, and building codes, regulations, and standards;

– explain the choice of structure and materials for a particular project;

– use appropriate equipment and techniques to describe, illustrate, and market various construction technology projects.

Building and Materials Application Skills

By the end of this course, students will:

– use various tools and equipment to calculate the dimensions of and to lay out appropriate structural members for footings, floors, walls, roofs, openings, and other parts of a construction project;

– demonstrate the measurement and layout skills required to build, assemble, erect, and install a variety of components related to construction technology;

– identify suitable materials for a variety of components of a construction project;

– use a variety of appropriate tools, equipment, and materials to complete a construction project;

– prepare accurate working drawings for a variety of projects;

– demonstrate an ability to design and, where appropriate, build a stairway for a construction project;

– demonstrate an ability to design and, where appropriate, build a fireplace for a construction project;

– complete a construction project using a variety of methods and procedures for laying out, assembling, and joining.

Skills Relating to Electrical, Mechanical, and Structural Systems

By the end of this course, students will:

– design and prepare drawings indicating the structural elements of a variety of construction projects;
– determine the size of structural members required for a construction project using charts, tables, technical data, and building codes, regulations, and standards;
– prepare and interpret electrical and mechanical drawings, and identify the components of the electrical and mechanical systems used in a variety of construction projects;
– calculate the size of the mechanical systems used in a construction project using charts, tables, and technical data;
– design and install, where appropriate, the mechanical systems of a building project (including electrical, plumbing, heating, ventilation, and air-conditioning systems) in accordance with building codes, regulations, and standards.

Estimating Costs

By the end of this course, students will:

– describe the units of measurement applicable to a variety of building products and how these units are used in estimating quantities for a construction project;
– calculate the quantities of materials and costs of labour for a project, using the area and volume estimating method, and technical data in charts and tables.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- explain the effects of technological change in the construction industry on society and on the environment;
- apply appropriate health and safety legislation; general shop and site safety rules; and rules specific to the use of materials, tools, and equipment;
- describe careers in construction technology, identifying the skills, education, and training required for each;
- identify and describe the employability skills required and the need for lifelong learning in the construction industry.

Specific Expectations

Economic, Social, and Environmental Impacts

By the end of this course, students will:

– explain how the local economy is directly linked to the construction industry;

– explain the social and environmental impacts on the construction industry of urban planning, land use by-laws, and building codes, regulations, and standards.

Health and Safety

By the end of this course, students will:

– identify hazards related to materials, processes, and equipment used in a construction work environment;

– demonstrate safe shop and construction site practices for the use of hand and power tools, materials, and equipment;

– describe the basic health and safety needs of workers on construction sites;

– identify, and apply where appropriate, safety codes, regulations, and standards applicable to construction projects and the workplace;

– explain how to handle hazardous materials in accordance with the Workplace Hazardous Materials Information Systems (WHMIS) guidelines.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify career opportunities in a variety of sectors of the construction industry;

– identify and describe the various skilled trades involved in the construction industry;

– describe the education and training required for employment in construction-related careers;

– explain the importance of lifelong learning for someone choosing a career in the construction field.

Construction Technology, Grade 12, College Preparation (TCJ4C)

This course focuses on advanced residential construction, more complex construction systems, and the introduction of heavy construction related to commercial, industrial, and/or recreational construction. Students will learn about the tools, materials, equipment, and methods used in the light and heavy construction industries; structural analysis and design; presentation and working drawings; and auxiliary systems. They will also estimate materials and labour costs; study industry standards and building codes; consider health and safety issues; and explore energy conservation, careers, and the impact of construction technology on society and the environment.

Prerequisite: Construction Technology, Grade 11, College Preparation

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services in response to complex challenges or problems in construction technology;
- explain advanced techniques, including computer applications, used to visualize, analyse, describe, and present designs of, and to construct, buildings and other structures (e.g., presentation and working drawings);
- describe the properties of natural and manufactured building materials, processes, and finishes;
- identify the building codes, regulations, and standards governing construction projects;
- describe appropriate building construction techniques; construction systems (electrical, mechanical, structural); and the building materials, tools, and equipment used in the construction industry.

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how a human need or want can be met through a new or improved product;

– apply the following steps of the design process to solve a variety of construction technology challenges or problems:
  □ identify what has to be accomplished (the problem);
  □ gather and record information, and establish a plan of procedures;
  □ brainstorm a list of as many solutions as possible;
  □ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
  □ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;
  □ produce presentation and working drawings, sketches, graphics, mathematical and physical models, or a prototype of the best solution;
  □ evaluate the prototype and determine the resources, including computer applications, required to produce it;
  □ communicate the solution, using one or more of the following: final drawings, graphs, charts, sketches, technical reports, electronic presentations, flow charts, mock-ups, models, prototypes, and so on;
  □ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Building Materials and Methods

By the end of this course, students will:

– describe the properties (physical, mechanical, structural, and thermal) of natural and manufactured building materials;

– describe the processes used to manufacture and prepare a variety of products (e.g., concrete and masonry, steel and metal products, gypsum, glass, plastics) used in the construction industry;

– describe the materials, and methods of applying them, used in various construction components (e.g., footings, foundations, floors, walls, roofs, windows, doors, millwork, interior and exterior finishes, hardware);

– identify a variety of building materials, construction techniques, architectural styles and details, and engineering features used in different construction projects;
– identify the insulation value of a variety of building materials;
– identify and explain the building codes, regulations, and standards applicable to construction projects.

Electrical, Mechanical, and Structural Systems

By the end of this course, students will:

– describe the operating principles of basic electrical, plumbing, heating, ventilation, and air-conditioning systems used in construction projects;
– use the terminology, symbols, industry standards, codes, regulations, and conventions related to the electrical, mechanical, and structural systems of a construction project;
– describe the types of loads and structural support members for footings, foundations, floors, walls, roofs, framing systems, bearing walls, columns, beams, lintels, and other parts of construction systems;
– describe the loads and the weight of materials, forces, and stresses for a variety of construction projects.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- demonstrate an understanding of design process skills by applying them to a variety of construction projects;
- interpret technical data, building codes, regulations, standards, specifications, and other construction resources;
- describe advanced residential and heavy construction systems, and demonstrate the appropriate technical skills for using the tools, equipment, and materials required to build the various components of a construction project;
- demonstrate the mathematical skills required to calculate the estimated cost of a construction project and the heat loss or gain for the project;
- describe a construction company's personnel, documents, and management structure.

Specific Expectations

Design, Planning, and Communication Skills

By the end of this course, students will:

– design (using effective brainstorming techniques), plan, and implement the best solutions for a variety of construction projects;

– apply design principles to, and identify good planning characteristics of, construction projects;

– research, document, and use resources applicable to construction projects such as technical data, charts, tables (e.g., on the strength, properties, and insulation values of materials), reports, zoning by-laws, and building codes, regulations, and standards;

– produce appropriate presentation and working drawings (including perspectives, floor plans, elevations, sections, and details), using traditional and computer-assisted methods, to meet client needs for a variety of construction projects;

– produce working drawings that accurately replicate the architectural features of a building;

– evaluate construction projects in relation to predetermined specifications;

– establish work schedules for a construction project;

– describe the electrical and mechanical system needs for construction projects, taking into consideration client needs and industry codes, regulations, and standards;

– design, and install when possible, the mechanical systems of a building project (including the electrical, plumbing, heating, ventilation, and air-conditioning systems) in accordance with building codes, regulations, and standards.

Building and Materials Application Skills

By the end of this course, students will:

– evaluate commercial property with respect to important design considerations (e.g., location according to type and use of building, services, zoning restrictions, and building codes, regulations, and standards);

– identify the major considerations related to the footings for a construction project;

– identify the features included in a foundation plan for a construction project;

– describe the components of a floor structure and estimate the quantities of materials required;

– identify structural elements of various construction projects or systems and explain the methods of construction and their advantages and disadvantages (e.g., wood structure using post and beam construction vs. traditional framing; steel frame structure vs. reinforced and precast concrete and masonry structures);
– explain the mechanical systems used in a construction project;
– describe various systems that allow movement within industrial, commercial, and public buildings (e.g., elevators, stairs, ramps, escalators);
– compare a variety of types of windows and doors used in construction projects;
– compare different construction techniques, building materials, and finishes used in construction projects;
– identify new building materials, tools, equipment, and techniques used in the construction industry;
– complete a construction project using a variety of tools and equipment for calculating and laying out;
– explain the reasons for selecting the structure and materials for a particular project;
– calculate the correct sizes of the structural members (e.g., footings, floors, walls, roofs, beams, columns) required for a construction project.

Estimates, Specifications, and Management Skills

By the end of this course, students will:

– prepare a materials list for a construction project;
– describe the units of measurement applicable to a variety of building products and materials used for complex construction projects;
– prepare a detailed, accurate estimate of the quantities of materials and costs of a building project, using conventional and computer-aided resources, charts, tables, technical data, and working drawings;
– calculate correctly heat gain, loss, or transfer and system capabilities in the design of heating, ventilating, and air-conditioning systems;
– describe a variety of types and sources of heating, cooling, and electrical systems;
– describe the organization, documents (e.g., work schedules, estimates), and management of a small construction company;
– identify and describe the roles of a variety of personnel involved in the construction industry (e.g., architects, engineers, lawyers, accountants, journeypeople, technicians, technologists, labourers);
– prepare documentation of all aspects of a construction project, including the process followed to obtain approval for a building permit and legal and contractual agreements with owners, architects, and subtrades.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- explain the impact of the construction industry on the economy, on society, and on the environment;
- evaluate construction projects in terms of efficiency and needs;
- apply health and safety legislation; general shop and site safety rules; and rules specific to the safe use of materials, tools, and equipment;
- identify careers in construction technology and the skills, education, and training each requires.

Specific Expectations

Economic, Social, and Environmental Impacts

By the end of this course, students will:

– describe natural and manufactured construction materials and the short- and long-term impact of their use on the environment;

– describe the economic and social impact of the activities of the construction industry;

– describe a number of ways of reducing negative environmental and social impacts through the choice of particular energy sources (e.g., alternative forms of heating such as the use of solar energy or heat pumps), materials, or products for construction projects;

– explain modifications to a building project that would improve its quality and value;

– identify factors to consider in community planning (e.g., population density, ecological and environmental factors).

Health and Safety

By the end of this course, students will:

– identify hazards related to the materials, processes, and equipment used in a construction work environment;

– demonstrate safe shop practices when using hand and power tools, materials, and equipment;

– describe the basic health and safety needs of workers on construction sites;

– explain the need for, and apply where appropriate, health and safety laws and regulations;

– identify safety codes, regulations, and standards applicable to construction projects and the workplace;

– explain health and safety legislation and practices related to the construction industry such as the Workplace Hazardous Materials Information System (WHMIS), the Worker's Compensation Act, the Ontario Building Code, and local by-laws;

– handle hazardous materials in accordance with the Workplace Hazardous Materials Information Systems (WHMIS) guidelines.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify career opportunities in a variety of sectors of the construction industry;

– describe the education and training required for employment in construction-related careers;

– identify postsecondary programs in construction technology and their admission requirements;

– explain the importance of lifelong learning for someone choosing a career in the construction field.

Construction Technology, Grade 12, Workplace Preparation (TCJ4E)

This course focuses on advanced residential and more complex construction systems, as well as the introduction of heavy construction, related to commercial, industrial, and/or residential construction; advanced practical workplace applications; and the development of generic employment skills and independent learning skills. Students will examine the materials, processes, labour, tools, and equipment used in the construction industry; technical drawings; auxiliary systems; and landscaping. They will also study industry standards and building codes; consider health and safety issues; and explore careers, lifelong learning opportunities, and the impact of construction technology on society and the environment.

Prerequisite: Construction Technology, Grade 11, Workplace Preparation

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services for a variety of complex construction renovation and landscaping projects;
- describe the properties of, and use where applicable, a variety of building and landscaping materials, techniques, and processes, including those involved in the production, assembly, and installation of prefabricated units and in renovation projects;
- describe a variety of construction technologies, materials and manufactured products, tools, and equipment used in construction projects;
- identify the building codes, regulations, and standards applicable to construction, including those for electrical, mechanical, and structural systems.

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how a human need or want can be met through a new or improved product;

– apply the following steps of the design process to solve a variety of construction technology challenges or problems:
  □ identify what has to be accomplished (the problem);
  □ gather and record information, and establish a plan of procedures;
  □ brainstorm a list of as many solutions as possible;
  □ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
  □ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;
  □ produce presentation and working drawings, sketches, graphics, mathematical and physical models, or a prototype of the best solution;
  □ evaluate the prototype and determine the resources, including computer applications, required to produce it;
  □ communicate the solution, using one or more of the following: final drawings, graphs, charts, sketches, technical reports, electronic presentations, flow charts, mock-ups, models, prototypes, and so on;
  □ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Building Materials and Methods

By the end of this course, students will:

– describe the properties (physical, structural, and thermal) of natural and manufactured building materials, and describe the processes used to produce or modify them;

– describe the materials used, and methods of applying them, for the various components of a construction project (e.g., footings, foundations, floors, walls, roofs, windows, doors, millwork, interior and exterior finishes, hardware, landscaping);

– identify the building codes, regulations, and standards applicable to complex construction projects;

– describe the relative strength of a variety of construction materials (e.g., wood, steel, concrete, masonry);

– identify the thermal and moisture protection properties of a variety of materials, as well as the methods of applying them.

Electrical, Mechanical, and Structural Systems

By the end of this course, students will:

- describe the various systems applicable to the construction industry, including electrical, plumbing, heating, ventilation, and air-conditioning systems;
- identify the requirements for the various systems used in different construction projects, using technical resources such as charts, tables, and building codes, regulations, and standards;
- identify the structural elements (including materials, spans, loads, forces, and methods of assembly) of complex construction projects;
- identify materials with a range of structural properties used for different parts of complex construction projects (e.g., footings, bearing walls, columns, beams and lintels, floor systems, ceiling and roof systems, retaining walls);
- identify the size of the structural members required for a variety of projects, using technical resources such as charts, tables, and building codes, regulations, and standards.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- apply the design process to a variety of construction projects;
- demonstrate an ability to use resources such as technical data, reports, charts, tables, and building codes, regulations, and standards;
- describe heavy construction systems in terms of predetermined criteria, type of construction, building use, and building codes, regulations, and standards;
- demonstrate an ability to use construction tools, materials, and equipment;
- demonstrate mathematical and estimation skills for a variety of construction projects;
- demonstrate the entrepreneurial, business, and management skills required in the construction industry.

Specific Expectations

Design, Planning, and Communication Skills

By the end of this course, students will:

– design, produce, repair, and maintain a variety of complex construction and landscaping projects;

– use both conventional and computer-aided methods to produce working drawings (e.g., site plans, floor plans, assembly drawings) – including elevations, sections, and details – for various construction projects;

– gather information and resources, and present solutions to construction problems;

– evaluate and document construction projects in relation to type of building, structural elements, aesthetics and architectural style, efficiency, and compliance with building codes, regulations, and standards;

– prepare accurate documents for complex construction projects, including cost estimates, bidding proposals, lists of material and labour costs, work orders, building permits, and specifications.

Building and Materials Application Skills

By the end of this course, students will:

– use various tools and equipment to calculate the dimensions of and to lay out appropriate structural members for footings, floors, walls, roofs, openings, walkways, retaining walls, slopes, elevations, and other parts of an advanced construction project;

– identify suitable materials for a variety of components of a construction project;

– use a variety of tools, equipment, and materials to complete a construction project;

– apply a variety of methods and procedures to assemble, join, and complete construction projects;

– prepare accurate working drawings for a variety of advanced construction projects;

– explain the type of structure and the materials used for a particular construction project.

Skills Relating to Electrical, Mechanical, and Structural Systems

By the end of this course, students will:

- prepare and interpret drawings to identify the components of a variety of electrical and mechanical systems used in construction;
- determine the components of the mechanical and electrical systems required for a construction project using charts, tables, and technical data;
- design and install where appropriate the mechanical systems of a building project (including those related to electrical, plumbing, heating, ventilation, and air-conditioning systems) in accordance with building codes, regulations, and standards;
- describe and calculate the sizes of the structural members required for a complex construction project, using technical resources such as charts, tables, and building codes, regulations, and standards.

Estimating Costs

By the end of this course, students will:

- describe the units of measurement applicable to a variety of building products and materials;
- calculate the quantities of materials and costs of labour for a project, using the quantity take-off method of estimation and technical data in charts and tables.

Entrepreneurial Skills

By the end of this course, students will:

- describe the attitudes, attributes, and skills of an entrepreneur;
- describe the characteristics of a construction industry organization that promotes an entrepreneurial spirit (e.g., the skills of creative thinking and decision making, flexible work schedules, a team approach, opportunities for management training and promotion, profit sharing);
- describe the organization and management functions in a small construction company;
- identify and describe the skilled construction trades;
- identify and describe the role of the skilled professionals involved with a small construction company (e.g., lawyers, accountants, architects, technologists, technicians);
- demonstrate entrepreneurial skills (e.g., managerial, critical and creative thinking, communication);
- prepare a business plan for a venture related to the construction industry.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- explain the effects of technological change in the construction industry on society and on the environment;
- apply appropriate health and safety legislation; general shop and site safety rules; and rules specific to the use of materials, tools, and equipment;
- describe careers in construction technology, identifying the skills, education, and training required for each;
- identify and describe the employability skills required and the need for lifelong learning in the construction industry.

Specific Expectations

Economic, Social, and Environmental Impacts

By the end of this course, students will:

– explain how the local economy is directly linked to the construction industry;

– explain the social and environmental impacts on the construction industry of urban planning, land use by-laws, and building codes, regulations, and standards;

– identify and describe renovations and modifications to various buildings and construction projects that could have an economic, social, and/or environmental impact on the community.

Health and Safety

By the end of this course, students will:

– identify hazards related to materials, processes, and equipment used in a construction work environment;

– demonstrate safe shop and construction site practices for the use of hand and power tools, materials, and equipment;

– describe the basic health and safety needs of workers on construction sites;

– explain the need for, and apply where appropriate, health and safety codes, standards, and regulations applicable to construction projects and the workplace;

– explain health and safety legislation and practices related to the construction industry such as the Workplace Hazardous Materials Information System (WHMIS), the Worker's Compensation Act, the Ontario Building Code, and local by-laws;

– explain how to handle hazardous materials in accordance with the Workplace Hazardous Materials Information Systems (WHMIS) guidelines.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify career opportunities in a variety of sectors of the construction industry;

– describe the education and training required for employment in construction-related careers;

– explain the importance of lifelong learning for someone choosing a career in the construction field;

– produce the necessary documentation (e.g., portfolios, résumés of experience and skills, references) for entry into the workplace;

– demonstrate the skills required to meet employer expectations in the construction industry.

Health and Personal Services

Overview

Health and personal services courses offer students an opportunity to investigate a variety of ways to improve their personal health and self-image, and at the same time gain a realistic introduction to one or more careers in the service industry. Students may choose to focus on such careers as child care provider, hairstylist, personal support worker, aesthetician, nurse, nail technician, geriatric care giver, make-up artist, and lab technician. In a growing service economy, the courses in health and personal services help prepare students for rewarding careers in many areas of employment.

Students will gain hands-on experience by using professional materials and equipment, practising current techniques, and using professional terminology related to their chosen trades. They will also acquire transferable problem-solving skills. Once they learn theoretical knowledge and practical skills pertaining to their areas of interest, students will be better prepared to make informed career choices. At the same time, they will expand their communication and interpersonal skills as they interact with their peers and clients. Through such close personal contact, students will gain both confidence in their ability to care for people and increased self-esteem.

For essential information on policy regarding multiple-credit courses and courses with particular areas of emphasis, see pages 6-7 of this document.

Health Care, Grade 11, College Preparation (TPA3C)

This course focuses on human anatomy, physiology, and basic medical terminology. Students will learn about the relationship between lifestyle and personal health, and conventional and alternative methods of disease prevention and treatment. They will also investigate health care procedures and equipment in nursing, medicine, and dentistry; examine health and safety issues in health care and the environmental and societal impacts of biotechnology; and explore various career opportunities in the health care field.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- demonstrate an understanding of human anatomy, physiology, and medical terminology;
- explain the relationship between lifestyle choices and personal health;
- compare conventional and alternative methods of disease prevention and treatment;
- identify patterns and trends in the health care industry;
- describe types and functions of instruments, equipment, and materials used in the health care industry.

Specific Expectations

Human Anatomy, Physiology, and Medical Terminology

By the end of this course, students will:

– demonstrate an understanding of human anatomy and physiology, including the functioning of body systems;

– correctly use basic terminology related to health care.

Lifestyle and Personal Health

By the end of this course, students will:

– explain the relationship among body systems and how they affect personal health (e.g., not taking in sufficient fluids may lead to digestive or urinary problems);

– identify relationships between lifestyle and the health of individuals of various ages;

– describe significant changes in the body during the life cycle;

– explain how lifestyle choices can have great impact on an individual's health and well-being (e.g., sleep, dietary and exercise habits, the use of tobacco, alcohol, and other drugs);

– assess a client's dietary strengths and weaknesses and make appropriate suggestions regarding client needs in terms of Canada's Food Guide and the nutritional value of foods;

– describe the benefits of different types of exercise and how physical fitness programs and equipment can promote health;

– demonstrate an understanding of factors relating to physical fitness by suggesting ways an exercise regimen could be improved;

– describe how sexual practices (e.g., unprotected sex) can have an impact on health;

– identify healthier personal lifestyles for themselves by evaluating their own lifestyle choices and habits;

– describe the organ donation program and its benefits.

Disease Prevention and Treatment

By the end of this course, students will:

– describe conventional and alternative (e.g., homeopathic remedies, acupuncture, therapeutic touch) methods of preventing and treating disease;

– analyse various types of home care available in the community in relation to specific patients' needs.

The Health Care Industry

By the end of this course, students will:

– identify and describe patterns and trends in the health care industry based on demographic information and changes in lifestyle;

– identify and determine the purpose of common instruments, equipment, and materials used for client care in the health care industry.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- use correct techniques and skills that meet industry standards in the health care field and explain the rationale for each technique;
- demonstrate effective communication, interpersonal, and teamwork skills.

Specific Expectations

Professional Techniques and Skills

By the end of this course, students will:

– perform proper hand-washing techniques at appropriate times;

– make beds (unoccupied and occupied) and give bed baths, completing each operation in the correct sequence;

– demonstrate safe feeding, toileting, turning, lifting, or transferring techniques;

– weigh a client correctly;

– describe appropriate techniques for dental and denture care;

– identify conditions requiring sterile procedures;

– explain what a decubitus ulcer and a contracture are and describe methods to prevent their occurrence;

– explain the difference between medical and surgical aseptic procedures;

– describe body substance precautions and other methods to decrease the spread of infection;

– explain the four types of vital signs and normal values for each;

– assess vital signs, such as temperature (e.g., by oral, axillary, and tympanic routes); pulse rate, rhythm, and strength (e.g., by apical and radial routes); respiration rate, rhythm, and depth; and blood pressure;

– explain how vital signs can be an overall reflection of an individual's health status;

– document case studies to produce client profiles;

– research and report on various health care procedures in nursing, medicine, and dentistry.

Communication, Interpersonal, and Teamwork Skills

By the end of this course, the students will:

– demonstrate effective communication, organization, teamwork, and personal management skills;

– use appropriate techniques of therapeutic communication;

– demonstrate effective interviewing skills and an ability to communicate client progress;

– describe professional decorum that is appropriate to specific health care situations (e.g., discrete handling of situations that might be embarrassing to the patient, treating information provided by patients confidentially);

– explain how to gather health data and the rules of confidentiality.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe the role and impact of biotechnology on Canadian society, the environment, and the global economy;
- describe health and safety procedures and their application to health care;
- identify educational requirements for careers in health care.

Specific Expectations

Effects of Biotechnology

By the end of this course, students will:

– describe the impact of biotechnology, pharmaceuticals, and health care on the economy, the role of government, and public opinion;

– explain how the health care industry is changing as a result of recent developments in technology;

– identify products designed to compensate for changes in the environment (e.g., sunscreen, air filtering systems, water purifiers).

Health and Safety Procedures

By the end of this course, students will:

– describe health and safety procedures, such as the use of proper body mechanics (e.g., being careful to bend with the knees instead of the back, having a wide base of support when lifting, or turning the full body instead of twisting the upper half of the body), and their application to health care;

– identify problems in health care caused by potentially unhealthy or unsafe conditions related to equipment, instruments, or materials;

– describe safe methods for the handling, storage, and disposal of waste, biohazardous materials and equipment, and outdated medication;

– operate health care and fitness equipment, tools, and materials safely.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify present health care career opportunities and those anticipated in the near future;

– identify education or training requirements for careers in health care.

Hairstyling and Aesthetics, Grade 11, Workplace Preparation (TPE3E)

This course provides students with opportunities to learn techniques in hairstyling and aesthetics that meet industry standards, using appropriate materials and equipment. Students will identify trends in the hairstyling and aesthetics industry; describe scientific and physical processes used in beauty services; learn to respect environmental, health, and safety laws; and explore career opportunities. The course may focus on either hairstyling or aesthetics, or may include a combination of both areas.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- describe trends and styles in hairstyling and aesthetics;
- demonstrate an understanding of the role and contributions of the beauty services industry to individuals and to society;
- identify materials, techniques, and equipment used in the hairstyling and aesthetics industry;
- describe scientific and physical processes used in various hairstyling and aesthetics services.

Specific Expectations

Trends and Styles

By the end of this course, students will:

– describe beauty fashion trends and the methods used to achieve them;

– describe a variety of health and beauty products;

– identify ways in which the hairstyling and aesthetics industry provides a service (e.g., using beauty treatments to pamper clients, interpreting and satisfying clients' needs, providing customer satisfaction and rapport);

– identify the role that beauty industry services play in increasing self-esteem and well-being.

Materials, Techniques, and Equipment

By the end of this course, students will:

– explain vocabulary related to the industry (e.g., words describing the structure of the hair, skin, and nails; the professional names for techniques, tools, and products used for services);

– describe various materials, processes, and equipment (e.g., types of shampoos, conditioners, masks, and cutting implements; massage techniques for the scalp, hands, and face; manicure procedures; wax heaters);

– describe traditional and new products and methods used in the beauty industry;

– select and use appropriate materials and tools to perform basic salon services.

Scientific and Physical Processes

By the end of this course, students will:

– explain chemical theory related to hair and skin products (e.g., acidity vs. alkalinity, pH balanced shampoos, hair colouring agents, chemical relaxers, permanent waves, emulsions, depilatories);

– describe chemical changes that take place during different procedures (e.g., oxidation of peroxide; breaking down sulfur bonds; actions of sodium hydroxide, ammonia thioglycolate, neutralizers);

– identify a variety of body reactions to different products and treatments;

– explain the difference between hypoallergenic and natural products (e.g., homemade skin care and health care products vs. products purchased from a beauty supplier), using information such as that provided on labels.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- identify a variety of services and techniques that meet industry standards;
- use appropriate materials and tools to perform basic salon services;
- demonstrate effective communication and interpersonal skills.

Specific Expectations

Services, Techniques, Materials, and Tools

By the end of this course, students will:

– describe basic analysis procedures (e.g., related to degree of porosity, scalp condition, skin type, facial shape, body type, health of nails) and recommend appropriate services;

– administer treatments following recommended procedures;

– select, prepare, and safely apply health and beauty products on live models or mannequins (e.g., skin and hair treatments, relaxers, tints, highlights);

– identify unique styles for special event occasions;

– identify and use appropriate routine sanitization procedures;

– use information technologies and specialized software related to the hairstyling and aesthetics industry (e.g., the Cosmopolitan Virtual Makeover program) effectively.

Communication and Interpersonal Skills

By the end of this course, students will:

– use effective communication techniques to interact with clients;

– identify techniques for resolving conflicts with clients and peers;

– identify and use a variety of teamwork and interpersonal skills.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe the environmental impact of products in the hairstyling and aesthetics industry;
- identify health and safety standards in the use of equipment, materials, and techniques;
- describe career opportunities and related training and educational requirements.

Specific Expectations

Environmental Impacts

By the end of this course, students will:

– describe the environmental impacts of various products used in the industry;

– identify environmentally friendly products.

Health and Safety Standards

By the end of this course, students will:

– describe laws and regulations related to the industry;

– describe and follow appropriate industry-standard health and safety procedures and regulations for handling products, tools, and equipment;

– apply personal health and safety standards correctly (e.g., by analysing skin, hair, and nails for disorders and diseases; sterilizing implements and equipment; wearing protective gloves during all chemical services; sanitizing hands; working in a properly ventilated area);

– describe first-aid and lifesaving techniques.

Education, Training, and Career Opportunities

By the end of this course, students will:

– describe local and regional career opportunities;

– identify training opportunities and educational requirements related to careers in hairstyling and aesthetics.

Child Development and Gerontology, Grade 12, College Preparation (TPO4C)

This course helps students understand the stages of development and needs of children and the elderly. Students will master the fundamental skills required to meet these needs; acquire an awareness of legislation governing the care of children and of elderly people who require support or supervision; evaluate social and recreational activities for children and the elderly; and assess available facilities. Students will also examine career paths in child and geriatric care, the impact of technological developments on products and services, and health and safety laws.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- describe the stages of child development and the stages of older adulthood;
- identify needs of children and the elderly at the various stages of development and of older adulthood;
- describe social and recreational activities and programs designed to meet the needs of children and the elderly at the various stages of development and of older adulthood;
- describe government legislation pertaining to the care of children and the elderly.

Specific Expectations

Stages of Development in Children and Stages of Older Adulthood

By the end of this course, students will:

– explain some of the major theories relating to child development and the stages of older adulthood;

– identify the stages of development in children and the stages of older adulthood as related to the major theories;

– describe and correct myths about early childhood development and aging.

Health Promotion

By the end of this course, students will:

– identify factors that contribute to the promotion and maintenance of the health and well-being of children and the elderly;

– explain the relationship among proper nutrition, physical activity, rest, sleep, and physical, psychological, social, spiritual, and cognitive well-being;

– describe the importance of social activities and outings on physical, psychological, social, spiritual, and cognitive well-being;

– explain the importance of promoting general physical, psychological, social, spiritual, and cognitive well-being;

– explain health and recreational requirements at different stages of development in children and at different stages of older adulthood;

– describe the effects of good nutrition on physical, psychological, and cognitive development;

– explain the requirements of balanced diets for children and the elderly according to Canada's Food Guide;

– describe various diets for people with special needs.

Meeting Needs

By the end of this course, students will:

– explain how different activity programs meet the physical, psychological, cognitive, spiritual, and social development needs of children and the elderly;

– identify appropriate and stimulating activities and games for the different stages of development of children and the different stages of older adulthood;

– explain the suitability of a variety of toys for the various stages of child development;

– identify different types of physical activities that meet particular developmental and health needs of children and the elderly;

– describe how environmental obstacles (e.g., lack of wheelchair access) affect the planning of activities for the elderly;
– design physical activity programs to help elderly people and children keep physically healthy;
– identify social and recreational activities to help children and elderly people adapt to new technologies (e.g., preschool software, network Scrabble, e-mail).

Government Legislation

By the end of this course, students will:

– identify government legislation that establishes procedures for the prevention of injuries to and neglect of children and elderly people who may require assistance or support;
– describe requirements and standards that need to be considered for children and the elderly;
– identify child welfare and protection services provided by municipal, provincial, and federal organizations.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- demonstrate techniques and practices needed to effectively assess and meet the physical, psychological, cognitive, spiritual, and social needs of children and the elderly;
- describe volunteer, public, and private sector programs and care services for improving the quality of life of children and/or the elderly.

Specific Expectations

Fundamental Skills

By the end of this course, students will:

– demonstrate appropriate hand-washing techniques and explain when they should be performed;

– use correct techniques for taking care of children and elderly people who require support in the following areas: feeding, bathing, providing a range of motion exercises, lifting and transferring, toileting and diapering, and caring for the skin;

– describe and demonstrate where applicable the correct use of safety devices or appropriate techniques for caring for children and elderly people;

– explain the correct use of ambulation devices used by children and elderly people (e.g., walkers, canes, wheelchairs) and how to teach someone to use these devices;

– describe the techniques of cardiopulmonary resuscitation (CPR), basic first aid, and the Heimlich manoeuvre;

– explain the theory and techniques associated with body substance precautions;

– describe how the health and well-being of children and the elderly can be assessed (e.g., in terms of body temperature, skin condition, infection or illness, abuse, difficulties in ambulation);

– describe and, where applicable, demonstrate the techniques of therapeutic communication and explain how communication skills must fit the stage or condition of children and the elderly;

– explain and apply pertinent human relations strategies that facilitate interpersonal relations with children of different ages and the elderly (e.g., talking to children in age-appropriate language, compensating for hearing or visual deficits in the elderly).

Programs and Services

By the end of this course, students will:

– describe various programs and services that focus on the physical, psychological, cognitive, spiritual, and social well-being of children and the elderly;

– identify services and products for improving the quality of life of children and the elderly;

– evaluate products and services (physical, psychological, cognitive, spiritual, and social) provided by various health care providers.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- identify factors that influence the health and safety of children and the elderly;
- describe and, where appropriate, apply laws and regulations related to health and safety in child care and the care of elderly people who require support or assistance;
- describe the role of society in caring for children and the elderly and the impact that an expanding aging population will have on society;
- describe the impact of technological developments on products and services and on health and safety laws;
- describe careers and related education and training requirements in child and geriatric care.

Specific Expectations

Health and Safety Factors

By the end of this course, students will:

– identify health and safety standards in the workplace that pertain to child and geriatric care;

– demonstrate the use of safety techniques and devices that are important in the care of children and the elderly;

– explain laws and regulations related to health and safety regarding child care, gerontology, and geriatrics;

– describe environmental impacts related to products developed to meet the needs of children and the elderly;

– follow routines for hygienic food preparation and for waste disposal.

Role of Society

By the end of this course, students will:

– describe the role of society in meeting the needs of and caring for children and the elderly;

– describe the impact that an expanding aging population will have on society.

Effects of Technology

By the end of this course, students will:

– explain technological changes that have influenced child and geriatric care (e.g., advances in the design of diapers, new skin care products, video monitoring from a remote site, computers, lifts);

– identify relationships between technology and community services (e.g., phone access for the hearing-impaired, video or Internet access to daycare centres from the home or workplace);

– describe relationships between technological developments and job opportunities in child and geriatric care (e.g., advances in medical technology that allow patients to go home on respirators have resulted in the growth of home-care jobs).

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify occupations that are concerned with products and services for helping children and the elderly;

– identify careers and related education, training requirements, and opportunities in child and geriatric care.

Medical Technologies, Grade 12, College Preparation (TPT4C)

This course focuses on human physiology, pathology, and immunology. Students will learn about accepted medical care practices, current technological advances in health care, and how to perform various procedures and use tools and equipment in the field of health care. Students will also design solutions to common medical and health care problems, investigate career opportunities, and examine laws and safety standards in the health care industry and the impact of this industry on the environment.

Prerequisite: Health Care, Grade 11, College Preparation

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- demonstrate an understanding of human physiology, pathology, and immunology;
- describe accepted practices in health care.

Specific Expectations

Human Physiology, Pathology, and Immunology

By the end of this course, students will:

– describe conditions required for the healthy functioning of microorganisms;

– explain the difference between various types and families of microorganisms;

– identify methods of microorganism identification;

– describe the mechanism of microbiological activity;

– explain the impact of enzymes in health and medicine;

– identify causes of various diseases and the body changes related to each;

– describe the functioning of a healthy immune system and explain what happens in the body when its functioning is impaired;

– explain how diseases spread and what measures are used to control them.

Accepted Practices in Medical Care

By the end of this course, students will:

– explain the evolution of health care practices;

– identify common medical problems and possible interventions;

– identify a range of medical services available (e.g., radiation, chemotherapy, and surgery for cancer treatment);

– describe abnormal values for each type of vital sign and identify appropriate interventions for each of these values;

– identify the resources needed to implement intervention plans;

– explain first-aid and cardiopulmonary resuscitation (CPR) procedures;

– identify preventive health screenings, examinations, and immunizations;

– describe cultural diversity as it applies to medical care (e.g., the need to respect religious beliefs such as those that preclude after-death care and blood transfusions, and cultural beliefs related to child birth and pain management);

– describe conventional health practices and alternative health practices (e.g., homeopathic remedies, acupuncture, therapeutic touch).

Skills and Processes

Overall Expectations

By the end of this course, students will:

- demonstrate correct techniques for performing various skills and for using the tools and equipment of the health care field;
- demonstrate an advanced understanding and use of medical terminology and communication techniques specific to health care.

Specific Expectations

Health Care Skills and the Use of Tools and Equipment

By the end of this course, students will:

– perform a range of health care skills to meet industry standards (e.g., proper hand-washing techniques, techniques to prevent the contamination of specimens);

– use tools and equipment in the health care field correctly;

– use appropriate apparatus and instruments (e.g., microscopes, slides, staining materials) to measure and collect data;

– apply procedures to identify microorganisms and their products;

– describe the principles and techniques of medical and surgical aseptic procedures;

– explain the correct techniques of sterilization in dental and medical processes;

– follow body substance precautions in handling body substances;

– design solutions to common medical and health care problems (e.g., improving methods to prevent the spread of flu in a nursing home).

Medical Terminology and Communication Techniques

By the end of this course, students will:

– use correct terminology for equipment, tools, and procedures;

– demonstrate an advanced understanding and use of medical care terminology;

– demonstrate advanced interviewing techniques;

– demonstrate communication skills (e.g., reflection, clarification, paraphrasing) to understand the needs of individuals;

– use language appropriate to specific situations;

– use the guidelines and methods of the lab or institution in which they are working to send and receive information;

– use computer technologies effectively to access, process, analyse, and present information.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe the impact of the health care industry on the environment;
- describe the laws and regulations governing health and safety standards in the health care industry;
- describe the impact of current or recent technological advances in the health care field;
- describe career opportunities in the health care industry.

Specific Expectations

Legal, Environmental, and Safety Issues

By the end of this course, students will:

– describe malpractice and other liability issues;

– describe existing and potential hazards to themselves, to clients, and to co-workers;

– describe and, where applicable, follow health and safety policies and procedures required to prevent injury or illness;

– describe work practices that promote a clean and healthy environment;

– identify recommended practices to reduce or eliminate pathogenic organisms;

– explain procedures designed to reduce the risk of infection;

– prevent the spread of pathogens by cleaning, disinfecting, or sterilizing surface instruments and equipment;

– maintain a sanitary food services environment and practise proper food handling;

– describe and, where possible, apply different laws and regulations for waste disposal;

– describe and, where possible, apply practices for recycling and waste management.

Technological Advances in Health Care

By the end of this course, students will:

– identify biotechnology products and their contribution to health care;

– explain the increasing role that biotechnology plays in our everyday lives;

– describe treatments that employ biotechnology (e.g., the use of vaccines and antibiotics);

– identify and explain bioethical issues that arise from advances in biotechnology;

– describe the impact on health care of current or recent technological advances;

– explain the environmental impact of technological advances in the health care field.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify career opportunities in the health care field;

– describe the education and training required for career opportunities in health care.

Hairstyling and Aesthetics, Grade 12, Workplace Preparation (TPE4E)

This course builds on the Grade 11 course to provide a solid foundation for students wishing to pursue a career in cosmetology. Students will continue to develop practical skills and knowledge pertaining to the beauty industry. They will also gain an awareness of the entrepreneurial skills required to own and operate a salon. The course may focus on either hairstyling or aesthetics, or may include a combination of both areas.

Prerequisite: Hairstyling and Aesthetics, Grade 11, Workplace Preparation

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- describe advanced design techniques used in hairstyling and aesthetics;
- solve problems related to specific client requests, needs, and expectations;
- explain the physical and chemical effects of beauty products on the hair, skin, and nails;
- identify strategies for effective salon operation and business ownership;
- describe advertising and marketing strategies.

Specific Expectations

Analytical and Design Techniques

By the end of this course, students will:

– determine appropriate services for a variety of clients through a consultation process;

– identify diseases and disorders relating to the hair, skin, and nails;

– explain colour theory concepts (e.g., colour wheel, warm and cool shades, hair colour formulation, make-up selection, complementary colours);

– describe the ways in which the design process is used in the hairstyling and aesthetics industry (e.g., the planning of appropriate style designs, balance in hairstyles, make-up artistry, or creativity in nail designs; sketching diagrams of styling and cutting patterns).

Physical and Chemical Effects

By the end of this course, students will:

– describe the potential effects of chemical applications on the hair, skin, and nails (e.g., effects of permanent hair colour, hair relaxers, prelighteners, toners, permanent waves, artificial nails, polish removers, alphahydroxy acids [AHA], topical solutions for the skin and nails);

– describe the differences between acid and alkaline levels (e.g., through the use of a pH chart) as they relate to hair and skin products (e.g., perms, shampoos, peroxides) and how these products affect the hair, skin, and nails;

– identify potential problems arising from product applications on the hair, skin, and nails.

Business and Marketing Considerations

By the end of this course, students will:

– identify the major steps required to open a beauty salon (e.g., create a business plan);

– identify terminology related to opening and operating a business (e.g., lease, business registration, contract, commission, inventory, retail, insurance);

– explain the importance of customer service;

– identify the influence of advertising and marketing techniques used to sell health and beauty products;

– describe advertising and management strategies as they relate to salon operations and new products, implements, and equipment used in the beauty industry.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- demonstrate business management skills in a salon setting;
- demonstrate problem-solving skills when dealing with a diverse clientele;
- demonstrate communication and interpersonal skills in a work environment;
- employ techniques that meet industry standards, including advanced styling techniques and chemical services applications, using appropriate equipment, materials, and implements;
- demonstrate effective communication and interpersonal skills.

Specific Expectations

Management Skills

By the end of this course, students will:

– identify the entrepreneurial skills required for operating a salon;

– demonstrate the organizational and record keeping skills required for inventory and finance;

– record and maintain client charts to ensure quality service;

– explain how to obtain information from a variety of sources to determine the best solution to a given problem (e.g., client consultation, client record card, colour charts);

– interpret diagnostic results to advise clients of appropriate services.

Services, Techniques, Equipment, and Materials

By the end of this course, students will:

– use skin and hair analysis procedures to determine the most suitable service, products, equipment, and techniques (e.g., for services such as manicures, pedicures, skin treatments, eyebrow shaping, make-up application, hair removal, advanced thermal styling, advanced dry and wet styling, artificial hair application, chemical services, corrective treatments, creative evening styles, and fantasy designs);

– apply hair colour according to client needs (e.g., tint retouch, virgin hair colour application, cap/foil highlights, lowlights, semi-permanent colour);

– competently perform services that chemically alter the structure of hair (e.g., permanent waves, soft curl perms, chemical relaxers), using a variety of advanced techniques;

– determine hair characteristics (e.g., texture, porosity, elasticity, density, lengths, amount of curl) of a variety of clients and determine the solutions that are most suitable and that best satisfy the clients' requests and needs;

– perform effectively a variety of fashion cuts that accentuate the client's best features by using advanced shaping techniques (e.g., texturizing, point cutting, blending, razor cutting, tapered cutting, blunt and layer cutting);

– use appropriate skin treatments (e.g., cleansers, tonics, exfoliants, treatment creams, masks, high frequency treatments) for specific client needs;

– interpret and adhere to manufacturers' directions on products and equipment related to the beauty industry;

– identify hair, skin, and nail abnormalities and advise clients on home care and preventive measures.

Communication and Interpersonal Skills

By the end of this course, students will:

– consult effectively with a variety of people in a client setting and use problem-solving skills to determine the most suitable services and products for the individual;

– demonstrate effective communication, organizational, teamwork, and personal management skills;

– demonstrate effective conflict management strategies that can be used in dealing with difficult clients or peers in problematic situations.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- evaluate effectively and implement the exemplary practices essential in an efficient and safe work environment;
- identify the role of legislation related to health and safety for a cosmetology program and to the beauty industry in general;
- explain the role of career education and training in hairstyling and aesthetic programs;
- make informed decisions concerning salon ownership.

Specific Expectations

Health and Safety Standards

By the end of this course, students will:

– use safe and sanitary work practices in performing hairstyling and aesthetic services;

– identify potential problems related to working in an unsanitary or unsafe environment;

– use and handle electrical equipment safely;

– interpret hazard labels associated with the WHMIS (Workplace Hazardous Materials Information System) and explain the purpose of this legislation in relation to the cosmetology profession;

– use and store waste and chemical products correctly;

– describe safety guidelines for the storage and disposal of chemicals.

Education, Training, and Career Opportunities

By the end of this course, students will:

– distinguish between the many and diverse careers related to the beauty industry;

– explain the training and apprenticeship programs required to prepare for possible employment in the wide field of cosmetology;

– identify considerations in business ownership and potential problems in opening a salon without proper preparation;

– describe the process to legally register a salon business.

Hospitality and Tourism

Overview

Hospitality and tourism courses focus on the hospitality industry, the world's largest employment sector. The courses prepare students to meet the challenges of this diverse industry by teaching them product preparation skills and by providing them with insight into tourism and travel.

Hospitality and tourism education provides both a hands-on and theoretical approach to various facets of the industry. Students will have the opportunity to develop essential food preparation, presentation, and customer relations skills; will learn about event coordination and marketing strategies, human resources, and inventory procedures; and will examine the cultural and economic forces that drive tourism trends. Students will work with equipment, use procedures, and adhere to health and safety regulations that are standards in the hospitality industry. They will acquire a foundation of skills and knowledge that will prepare them for both postsecondary education and careers.

For essential information on policy regarding multiple-credit courses and courses with particular areas of emphasis, see pages 6-7 of this document.

Hospitality, Grade 11, College Preparation (TFT3C)

This course helps students understand the features, trends, and guidelines of the hospitality industry, as well as learn the basic requirements of serving customers. Students will acquire skills related to preparing and presenting food, evaluating facilities, controlling inventory, and marketing special events. They will also learn about economic and environmental impacts, health and safety standards, and career opportunities related to the hospitality industry.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- explain the purpose of nutrition and use Canada's Food Guide as a tool to assess the nutritional needs of their clients;
- identify culinary trends based on demographic information;
- describe the basic principles of customer service, including establishing the desired ambience (e.g., atmosphere and professionalism of the staff) for customers;
- identify product preparation and presentation techniques.

Specific Expectations

Food and Nutrition

By the end of this course, students will:

– describe the importance of food research;

– explain the essential principles of nutrition;

– explain how lifestyle, health, and age affect dietary needs;

– explain how various types of nutrients in foods are used;

– identify physical and chemical changes that may occur when food is handled, cooked, or stored;

– identify the impact on the hospitality industry of the effects that weather has on the availability, quality, and pricing of products.

Culinary Trends and Demographics

By the end of this course, students will:

– identify the different styles of cooking a variety of foods;

– identify current culinary trends;

– describe the impact of cultural diversity on the accommodation and on the food and beverage sectors of the hospitality industry.

Customer Service Principles

By the end of this course, students will:

– identify different types of restaurant service;

– describe the functions and responsibilities of, and identify differences between, the "front of the house"(service personnel) and "back of the house" (kitchen workers) operations;

– describe the importance of company policies and procedures for improving or maintaining quality of service;

– identify and apply appropriate customer service attitudes.

Food Preparation and Presentation

By the end of this course, students will:

– identify cooking applications (i.e., conduction, convection, radiation, fusion), their appropriate methods, and their effects on products;

– identify cooking methods (i.e., using dry heat as in roasting or frying and moist heat as in boiling or poaching) and their effects on food;

– describe common ingredients used in cooking and for garnishing food;

– identify a variety of herbs and spices.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- identify and, where possible, apply procedures for inventory control;
- prepare and present food in a variety of ways;
- describe and compare the characteristics of various hospitality facilities;
- design effective marketing initiatives to promote special events.

Specific Expectations

Inventory Management

By the end of this course, students will:

– identify and apply procedures for ordering, shipping, and receiving products;

– describe and apply procedures for storing, rotating, and maintaining inventory.

Food Preparation and Presentation

By the end of this course, students will:

– prepare food for special dietary needs;

– describe the fundamentals of imperial and metric measurement and make conversions to amounts of ingredients in recipes;

– prepare a variety of garnishes and use them with a variety of fish, meat, poultry, and dessert dishes;

– describe how dried and fresh herbs and spices affect products in preparation;

– apply appropriate baking techniques and procedures to produce desserts;

– describe the effect of freezing foods;

– use various cooking techniques and presentation methods to enhance dishes;

– explain how to incorporate basic nutritional principles in menu planning;

– describe the effect of different recipe formats;

– apply mathematical formulas to calculate the actual cost of food;

– describe physical and chemical changes that take place when mixing raw ingredients;

– prepare stocks, soups, and sauces, as well as meat, fish, seafood, and poultry dishes;

– describe and apply food handling, serving, and storage techniques that meet health and safety standards.

Facilities Management

By the end of this course, students will:

– explain the significance of colour, layout, and lighting to food services and to accommodation facilities;

– describe the economic factors, codes, and regulations that must be considered when building, renovating, or restoring a variety of facilities;

– identify factors that determine the parameters of a conference or event;

– identify various types of hospitality operations and the types of facilities that they require;

– identify the resources and supplies required by a hospitality operation.

Marketing and Publicity

By the end of this course, students will:

– identify various marketing strategies and explain how they are used to promote services and products;

– develop effective marketing strategies to promote selected services and products;

– describe the importance of production schedules in planning events;

– develop an appropriate production schedule for selected events;
– describe equipment and technologies used in promotional presentations;
– use a variety of equipment and technologies for promotional presentations.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- explain the relationship between the economy and the hospitality sectors;
- describe the impact of the hospitality industry on the environment;
- identify and, where appropriate, apply standards for health and safety in the hospitality industry;
- describe various career opportunities in the hospitality industry and the education and training related to each;
- identify the individual personality traits and skills that lend themselves to a career in the hospitality industry.

Specific Expectations

Economic Impacts

By the end of this course, students will:

– explain different processes used by businesses to increase market share and how this may affect the economy;

– describe the role of trade shows and conferences;

– identify economic impacts of computer technology on the hospitality industry;

– describe the role of government and associations in the hospitality sector.

Environmental Impacts

By the end of this course, students will:

– explain the importance of how food is grown and processed to agriculture, to the environment, and to rural communities;

– describe disposal procedures for waste food products.

Health and Safety

By the end of this course, students will:

– describe types of emergency situations that can occur in the hospitality industry and the kind of assistance required in each case to ensure public safety;

– identify the role of workplace health and safety organizations in determining hospitality industry standards;

– explain the necessity for standardization in company policies;

– describe and, where appropriate, apply standards, codes, and legislation for health and safety in the hospitality industry.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify educational requirements associated with various jobs in the hospitality industry;

– describe career paths and the factors that affect salary structures for various positions of responsibility in the hospitality industry;

– determine whether their interests, skills, and attitudes suit a career in a hospitality occupation.

Hospitality and Tourism, Grade 11, Workplace Preparation (TFH3E)

This course focuses on food preparation and management, and hospitality and tourism activities, equipment, and facilities. Students will learn how to prepare, present, and serve food; plan, manage, and promote activities; and use the necessary equipment. Throughout the course, they will learn the fundamentals of providing high-quality service and customer satisfaction. Students will also study the occupational health and safety standards and laws regulating the hospitality and tourism industry, explore the industry's social and environmental impacts, and identify possible career paths.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end this course, students will:

- identify the eight sectors of the hospitality and tourism industry – accommodation, adventure tourism/recreation, food and beverage, transportation, travel trade, events and conferences, attractions, and tourism services;
- identify the characteristics of a variety of foods;
- describe food product handling, storage, and preparation techniques;
- demonstrate familiarity with the equipment and facilities used in the hospitality and tourism industry.

Specific Expectations

Industry Services and Sectors

By the end of this course, students will:

– describe the eight sectors of the tourism industry;

– describe the services offered by each of the sectors of the hospitality and tourism industry;

– describe interdependent hospitality and tourism services;

– explain the goals of ecotourism and adventure tourism;

– identify the sectors of the tourism industry that are prominent in the province, the region, and the local community;

– identify businesses and industries that benefit from the tourism industry or that owe their existence to it;

– identify local tourism facilities and describe how they attract people.

Knowledge of Foods

By the end of this course, students will:

– describe commonly used ingredients in cooking and baking;

– list the basic nutritional values of a variety of products;

– identify different herbs and spices.

Handling of Foods

By the end of this course, students will:

– explain the effect of temperature changes on food;

– apply National Sanitation Code cleanliness standards during the handling, storage, and preparation of products;

– identify the causes and describe the effects of food poisoning;

– describe the purpose of the Public Health Act and the Food and Drug Act.

Equipment and Facilities

By the end of this course, students will:

– demonstrate a familiarity with a variety of equipment related to hospitality and tourism;

– identify a variety of accommodation facilities.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- manage activities, equipment, and personnel effectively to provide service to customers;
- apply correctly principles related to the preparation, presentation, and service of food products;
- prepare effective publicity campaigns.

Specific Expectations

Customer Service

By the end of this course, students will:

– identify and describe the safe use, set-up, and maintenance of equipment used in a variety of activities;

– relate equipment to client needs and interests;

– control product reception, handling, storage, and rotation effectively;

– explain the importance of teamwork in providing customer service;

– apply correctly standards of personal hygiene and grooming;

– explain the importance of uniforms in the hospitality and tourism industry;

– meet the needs of customers;

– explain the importance of providing respect for people with a variety of needs.

Food Preparation and Presentation

By the end of this course, students will:

– prepare simple recipes using available ingredients;

– describe cooking and baking procedures and concepts;

– describe regional food products in terms of availability and variety;

– measure quantities correctly in both imperial and metric units;

– convert recipes correctly to increase or decrease their yield;

– prepare vegetables, stocks, soups, sauces, meat, poultry, fish, seafood, and a variety of desserts.

Marketing and Publicity

By the end of this course, students will:

– identify the objectives of advertising campaigns;

– apply principles of advertising for school and special events;

– assess a marketing campaign for a local tourism attraction in terms of its effectiveness in attracting customers;

– apply the principles of marketing to design a tourism campaign for a local event;

– use computer software to prepare and present publicity and marketing documents.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe social, economic, and environmental impacts of the hospitality industry;
- describe and, where appropriate, apply industry standards of health and safety for the use of materials, tools, and equipment in the hospitality and tourism industry;
- identify career possibilities in the hospitality and tourism industry;
- identify the individual personality traits and skills that lend themselves to a career in tourism.

Specific Expectations

Social, Economic, and Environmental Impacts

By the end of this course, students will:

– describe the social and economic impact of new products and modern technologies on the industry;

– explain how the eight sectors of the tourism industry affect the national, provincial, and local economies;

– describe environmentally friendly disposal procedures for waste food products and packaging (e.g., composting, recycling).

Health and Safety

By the end of this course, students will:

– identify the safety factors that must be considered in the workplace;

– use a first-aid kit correctly;

– describe types of emergency situations than can occur in the hospitality and tourism industry and the kind of assistance required in each case to ensure safety;

– identify and, where appropriate, apply health and safety acts and regulations that pertain to the hospitality and tourism industry.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify a range of occupations in the tourism industry;

– identify trades and professions in hospitality and tourism and the training and education related to each;

– determine whether their interests, skills, and attitudes suit a career in a tourism occupation;

– describe possible career paths in the tourism industry;

– identify the factors that affect salary structures in the different sectors of the tourism industry.

Tourism, Grade 12, College Preparation (TFS4C)

This course provides students with opportunities to analyse the characteristics and standards of the tourism industry, determine the factors that promote its success, and investigate principles and procedures that contribute to high-quality customer service. Students will also assess facilities and activities that attract tourists, and study communication and customer service techniques. In addition to exploring career opportunities, students will analyse the relationship between tourism and the economy and propose ways to enhance the performance of the industry.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- describe key characteristics of the eight sectors of the tourism industry – accommodation, adventure tourism/recreation, food and beverage, transportation, travel trade, events and conferences, attractions, and tourism services;
- describe the local, provincial, national, and global impacts of tourism;
- identify factors that promote the success of the tourism industry;
- identify principles and procedures used to facilitate providing service to customers and techniques for communicating with customers.

Specific Expectations

Industry Characteristics

By the end of this course, students will:

– describe various types of services, activities, and events associated with the tourism industry;

– describe the roles of business, labour, and government in the tourism industry;

– describe the services provided to clients by various types of travel or service agencies and through web sources (e.g., ticket sales for special events, itineraries, tours);

– identify ways of improving the image of the tourism industry.

Success Factors

By the end of this course, students will:

– describe factors that have contributed to the growth of the tourism industry;

– describe how the industry meets the needs of tourists;

– identify target customers and develop appropriate marketing strategies for them;

– identify components of tourism packages;

– explain the different needs of pleasure and corporate travel;

– describe types of tourist destinations and the lure of each;

– research and describe the impacts of different areas of tourism locally, provincially, nationally, and globally.

Customer Service

By the end of this course, students will:

– identify ways of providing services to clients in the following settings: hotels, restaurants, private clubs, health spas, resorts;

– explain the importance of listening to a client's complaints and rectifying the situation;

– solve problems and help customers when problems arise;

– identify potential problems that may arise in the following types of tourism operations: hotels, resorts, restaurants, private clubs, health spas, outdoor settings.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- promote a variety of activities and events in the tourism industry effectively;
- plan and implement an event or an activity associated with tourism;
- explain the management strategies and processes of a variety of tourism activities.

Specific Expectations

Event/Activity Design and Implementation

By the end of this course, students will:

– describe the importance of special events for the community;

– identify ways of encouraging employees to promote products and services;

– describe and design marketing strategies for the promotion of a product, service, or activity related to tourism;

– design a successful action plan to promote an activity or an event;

– design, plan, and implement effectively a tourism activity or event, keeping in mind the specific needs of the target clientele;

– explain the success of an event or activity in relation to its action plan and make recommendations for improvement.

Management Strategies and Processes

By the end of this course, students will:

– conduct an accurate financial analysis for a tourism activity and identify its implications;

– produce an effective impact analysis of different management styles in various tourism situations;

– describe strategies to manage high-risk tourism activities;

– identify the principles and responsibilities of tourism management;

– design and construct an effective tourism market survey;

– use computer technology to design and implement tourism events or activities (e.g., promotion, record keeping, forecasting).

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe the impact of the tourism industry on the environment and the economy in general;
- identify methods to enhance the performance of the tourism industry;
- identify health and safety standards for the tourism industry;
- describe career opportunities in the tourism industry;
- identify the individual personality traits and skills that lend themselves to a career in tourism.

Specific Expectations

Environmental and Economic Impacts

By the end of this course, students will:

– describe the growth of and changes in the tourism industry;

– explain the need to organize events for communities and the advantages of doing so;

– identify the potential for recreational tourism in the community;

– describe the responsibility of the tourism industry to use natural resources and the environment wisely;

– identify different modes of transportation used in the tourism industry and their economic and environmental impact;

– describe the role of computer technology in the tourism industry, as well as its economic impact on the industry;

– identify the impacts of the eight sectors of the tourism industry on the national, provincial, and local economies.

Health and Safety Factors

By the end of this course, students will:

– explain the impact of health and safety regulations related to the tourism industry;

– apply health and safety laws and regulations in the planning and implementation of events and activities.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify available careers in the tourism industry and the education and training required for each;

– identify trends in the industry and their impact on job creation;

– determine whether their interests, skills, and attitudes suit a career in a tourism occupation;

– describe possible career paths in the tourism industry.

Hospitality and Tourism, Grade 12, Workplace Preparation (TFH4E)

This course focuses on advanced food preparation and presentation skills; event and activity planning; the equipment and facilities used in the hospitality and tourism industry; and tourist attractions. Students will study the nutritional value of foods, plan menus and recipes, develop management techniques, design and implement an event, and learn effective communication skills. They will also explore careers, the impact of the hospitality and tourism industry on society and the environment, and health and safety standards in the workplace.

Prerequisite: Hospitality and Tourism, Grade 11, Workplace Preparation

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- demonstrate an understanding of the importance of tourism at the local, provincial, national, and global level;
- explain the importance of each of the eight sectors of the hospitality and tourism industry – accommodation, adventure tourism/recreation, food and beverage, transportation, travel trade, events and conferences, attractions, and tourism services;
- explain the importance and value of nutrients in food products;
- describe a variety of tourism attractions and their physical layouts or plants;
- identify the equipment and facilities used in the hospitality and tourism industry.

Specific Expectations

Tourism Sectors and Services

By the end of this course, students will:

– describe the importance and impact of tourism at the local, provincial, national, and global level;

– describe the importance of the attractions and adventure tourism/recreation (e.g., ecotourism) sectors of the tourism industry;

– identify international tourism facilities and world-renowned landmarks;

– describe the impact of the hospitality and tourism industry on transportation;

– explain the economic value of tourist attractions;

– identify components of the tourism services sector of the tourism industry;

– explain the relationship of the accommodation sector to others sectors of the tourism industry;

– describe various roles of the travel trade sector in the tourism industry;

– identify demands made by the events and conferences sector of the tourism industry on the rest of the industry;

– describe the link between geographic regions and the tourism industry;

– identify the various national and provincial associations that support tourism activities.

Nutrition

By the end of this course, students will:

– describe the nutritional value of a variety of food products;

– describe various food processing techniques and their effects on nutritional values;

– identify the differences between organically grown fruits and vegetables and those grown using chemical additives;

– explain the effect of dietary supplements in meat production.

Equipment and Facilities

By the end of this course, students will:

– describe the equipment needed to operate a restaurant;

– identify the characteristics of different types of facilities (e.g., health spa, hotel, resort, bed and breakfast operation, country club);

– explain the importance of community buildings and describe ways to use them for hospitality and tourism purposes;

– describe how a variety of outdoor equipment is used in the hospitality and tourism industry.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- design and manage a school or community activity or fund raiser;
- use advanced product preparation and presentation skills to plan and prepare menus;
- handle and store foods safely and hygienically;
- use management techniques to complete a variety of tasks;
- identify various communication strategies to ensure customer service.

Specific Expectations

Event/Activity Planning

By the end of this course, students will:

– design, plan, and implement an activity or fund raiser for the school or the community (e.g., a Community Connection Day);

– explain the success of an activity or fund raiser in relation to its action plan and make recommendations for improvement;

– effectively use a variety of software applications in the planning, promotion, and realization of an activity or fund raiser.

Product Preparation and Presentation

By the end of this course, students will:

– prepare, present, and serve a variety of food products;

– prepare correctly various types of beverages;

– prepare complex recipes accurately using available ingredients;

– describe a variety of recipe structures;

– perform accurate measurements, metric conversions, and calculations of yield for various types of recipes;

– prepare a variety of recipes in accordance with culinary traditions.

Handling of Foods

By the end of this course, students will:

– describe personal hygiene practices;

– perform food handling, serving, and storage techniques that conform with health and safety standards;

– explain food storage practices and inventory procedures;

– manage inventory effectively and use correct purchasing techniques.

Management Techniques and Customer Service Standards

By the end of this course, students will:

– use time management and teamwork skills to plan and manage a variety of events and activities;

– describe effective customer service techniques for a variety of settings;

– explain the need for sensitivity in responding to client needs;

– use software programs to improve customer service.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe the impact of the hospitality and tourism industry on the environment and the economy;
- identify health and safety standards for the hospitality and tourism industry;
- describe career opportunities and the education and training required for each;
- identify the individual personality traits and skills that lend themselves to a career in tourism.

Specific Expectations

Environmental and Economic Impacts

By the end of this course, students will:

– describe the effects of pollution on the tourism and hospitality industry;

– identify the impact that the industry has on the environment;

– describe ways in which the tourism industry affects social behaviour;

– explain how the eight sectors of the tourism industry affect the national, provincial, and local economies;

– describe the industry associations and explain their importance to the development of strong local and provincial economies.

Health and Safety Factors

By the end of this course, students will:

– describe food-borne illnesses and ways to avoid contamination;

– identify solutions for health and safety problems;

– describe and, where appropriate, apply health and safety standards, codes, and legislation;

– explain ways to meet health and safety requirements in various settings of the hospitality and tourism industry.

Education, Training, and Career Opportunities

By the end of this course, students will:

– outline job opportunities and educational requirements for careers in the hospitality and tourism industry;

– identify the lifestyle and personal choices that can accompany a career in tourism (e.g., shift work, seasonal work);

– explain the importance of employability skills and attitudes to success in the tourism industry;

– describe the skills and attitudes required for careers in the hospitality and tourism industry;

– determine whether their interests, skills, and attitudes suit a career in a tourism occupation;

– describe possible career paths in the tourism industry.

Manufacturing Technology

Overview

Manufacturing is the transformation of materials into products to meet human needs and wants. In today's global economy, manufacturing is the foundation of a nation's wealth and power. These courses provide students with opportunities to acquire the knowledge and skills needed to understand, use, and manage manufacturing systems. They will also help students understand the role of manufacturing technology in our economy; its relationship to other economic sectors; and its effects on people, society, and the environment. Their study of manufacturing technology will prepare students for change and for making critical decisions regarding the future.

For essential information on policy regarding multiple-credit courses and courses with particular areas of emphasis, see pages 6-7 of this document.

Note: Working with wood as a material, other than in building construction, can be one of the areas of application in the manufacturing courses.

Manufacturing Engineering Technology, Grade 11, College Preparation (TMJ3C)

This course focuses on design principles; electronic, pneumatic, and hydraulic control systems; and traditional and advanced manufacturing processes. Students will solve problems and make the critical decisions necessary to develop efficient production systems. They will also study the broad range of career opportunities available in the manufacturing sector and their educational requirements, and will research the scope of the manufacturing industry and the impact of its products on individuals, society, and the environment.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services in response to challenges or problems in manufacturing technology;
- identify appropriate materials and processes to produce products to meet human needs and wants;
- describe the production process required to develop a product;
- evaluate the types of control systems used in production processes and products.

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how a human need or want can be met through a new or improved product;

– apply the following steps of the design process to solve a variety of manufacturing technology challenges or problems:
  □ identify what has to be accomplished (the problem);
  □ gather and record information, and establish a plan of procedures;
  □ brainstorm a list of as many solutions as possible;
  □ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
  □ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;
  □ produce presentation and working drawings, sketches, graphics, mathematical and physical models, or a prototype of the best solution;
  □ evaluate the prototype and determine the resources, including computer applications, required to produce it;
  □ communicate the solution, using one or more of the following: final drawings, graphs, charts, sketches, technical reports, electronic presentations, flow charts, mock-ups, models, prototypes, and so on;
  □ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Materials and Production Processes

By the end of this course, students will:

– identify destructive and non-destructive tests to evaluate material choice;

– evaluate material properties using computers and report the results;

– investigate and evaluate the following materials before choosing the most appropriate materials for a product: metals (ferrous and non-ferrous), polymers (e.g., natural – wood, cellulose; synthetic – plastics), ceramics (e.g., clay, glass, oxides, cement, carbides), composites (e.g., filler, particle, laminate, flake, fibre), and natural materials;

– describe the conditioning processes that change a material's physical and mechanical characteristics and properties;

– explain the three methods of conditioning materials: thermal conditioning, chemical conditioning, and mechanical conditioning;

– identify semiconductor devices, numeric controls, digital electronic devices, pneumatic and hydraulic devices and controls, and electrochemical devices, and describe how they are used in the production process.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- effectively plan, organize, direct, and control various manufacturing activities;
- use current technology and production skills in the development of a process or a product;
- operate a manufacturing system and analyse the efficiency of the system;
- use effective techniques to model and communicate product ideas, materials, and specifications;
- use mathematical and language skills effectively and apply technological systems and scientific principles to design material processing and management systems.

Specific Expectations

Organizational Skills

By the end of this course, students will:

– develop systems for production, marketing, personnel, and financial control;

– use computers to help develop, operate, and control systems;

– apply the concepts of work flow, products per period of time, and defect rate when analysing and testing the efficiency of a production line;

– use appropriate techniques to sketch solutions to scale showing orthographic and isometric views;

– use appropriate techniques to mock up or model potential solutions to challenges;

– select and use appropriate software in the development of marketing strategies.

Technology and Production Skills

By the end of this course, the students will:

– use a wide variety of appropriate hand and machine tool skills in the assembly or fabrication of a product or manufacturing process;

– choose the most appropriate production method by conducting a test run in the manufacture of a product or process;

– analyse and explain the results of producing products in a particular manufacturing process;

– modify particular operations and tooling to improve the manufacturing process.

Quality Control Skills

By the end of this course, students will:

– use a number of quality control processes when fabricating products;

– design and implement inventory and production control systems;

– use quality control methods such as statistical process control to monitor the efficiency of manufacturing processes, and record results using spreadsheets.

Communication Skills

By the end of this course, students will:

– create process control charts that clearly outline the stages of the production process;

– use detailed working drawings and assembly drawings to depict the components of the product or process;

– develop a bill of material that indicates the specifications and quantity of a particular part of the product or process;

– conduct an accurate cost analysis of the final product or process;
– develop appropriate engineering drawings using a computer-aided drawing program;
– develop engineering reports that communicate the specifics of the product or process;
– prepare and present effective oral reports on the product or process.

Interdisciplinary Applications

By the end of this course, students will:

– explain the technological systems approach and how it relates to manufacturing: inputs (materials, labour, capital), processes (material processing), and outputs (for industry or the consumer market);
– apply mathematical skills in spreadsheet analysis to measure to close tolerances machining speeds and production rates per unit of time and to control inventory, costs, quality, and sampling;
– explain how science or scientific principles or practices apply to material selection and specifications, energy consumption, worker fatigue, material processing, and the design of ergonomically appropriate products that accommodate the human form;
– use appropriate language in flow charts, operation and inspections charts, job descriptions, formal presentations, bills of material, and lists of tooling requirements or materials for quality control programs.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- demonstrate an ability to make informed decisions concerning the social, economic, and environmental consequences and impact of the manufacturing sector;
- demonstrate the exemplary practices that are essential to safe work environments and practices;
- identify the role of health and safety legislation in manufacturing technology programs in schools and in the manufacturing sector;
- describe the career opportunities in manufacturing engineering.

Specific Expectations

Impacts

By the end of this course, students will:

– describe the social and economic consequences of manufacturing activity for individuals and for society;

– describe the impact of manufacturing activity on the environment and identify a variety of materials, processes, and waste management methods to minimize negative impact.

Safety and Legislation

By the end of this course, students will:

– apply safe work practices in performing manufacturing-related processes;

– identify potential hazards in their workplace by conducting safety audits and inspections;

– describe specific components of the Occupational Health and Safety Act and the actions required on their part to adhere to the act;

– describe the Workplace Hazardous Materials Information System (WHMIS) and explain the importance of consulting material safety data sheets (MSDS) whenever appropriate;

– recognize the meaning of the hazard labels associated with WHMIS.

Education, Training, and Career Opportunities

By the end of this course, students will:

– describe the scope of career opportunities within the manufacturing sector;

– identify the specific educational and training requirements necessary for careers in the manufacturing sector;

– describe career programs such as cooperative education and the Ontario Youth Apprenticeship Program (OYAP);

– distinguish among the careers of technician, technologist, and engineer and identify the education required for each.

Manufacturing Technology, Grade 11, Workplace Preparation (TMJ3E)

This course helps familiarize students with the broad range of career opportunities within the manufacturing sector. Students will acquire design and fabrication skills using a variety of materials, tools, equipment, and processes, and will construct products that adhere to design specifications and meet quality control standards. In addition to developing employability and technical skills, students will develop an understanding of the impact of the manufacturing sector on consumers, society, and the environment.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services in response to challenges or problems in manufacturing technology;
- identify the physical and mechanical characteristics of the materials and processes required to produce a product or process;
- explain the four material conversions: separation of materials (e.g., cutting), addition of materials (e.g., welding), contour changes of materials (e.g., forming), and internal changes of materials (e.g., heat treatment to harden, anneal, normalize).

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how a human need or want can be met through a new or improved product;

– apply the following steps of the design process to solve a variety of manufacturing technology challenges or problems:
  □ identify what has to be accomplished (the problem);
  □ gather and record information, and establish a plan of procedures;
  □ brainstorm a list of as many solutions as possible;
  □ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
  □ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;
  □ produce presentation and working drawings, sketches, graphics, mathematical and physical models, or a prototype of the best solution;
  □ evaluate the prototype and determine the resources, including computer applications, required to produce it;
  □ communicate the solution, using one or more of the following: final drawings, graphs, charts, sketches, technical reports, electronic presentations, flow charts, mock-ups, models, prototypes, and so on;
  □ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Materials and Production Processes

By the end of this course, students will:

– identify the physical, mechanical, thermal, chemical, electrical, magnetic, optical, and acoustical properties of materials;

– describe the following physical properties of materials: appearance, density, moisture, content, porosity, size, surface texture, weight;

– describe the following mechanical properties of materials: brittleness, compression, ductility, elasticity, fatigue, hardness, impact, plasticity, shear, torsion, tensility;

– explain the following material conversions: the separation process (converting a material's size and shape by removing excess material), the addition process (combining

materials to achieve enhanced qualities such as in alloys), the process of making changes to contours (assembling materials by such means as gluing, mixing, fastening, bonding, and welding), the process of making internal changes (thermal, chemical, or mechanical conditioning);

- identify the factors that affect material selection;
- describe the different forms and characteristics of wood and wood composites, metals and alloys, plastics, earth materials, and composites;
- describe the advantages of using a variety of materials, such as different species of woods, metals and alloys, plastics, earth materials, and composite materials.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- function effectively as individuals and as members of a cooperative team to produce a product;
- use current technology and production skills in the development of a product;
- identify and choose the most appropriate power and control systems to develop a product;
- communicate project ideas effectively using engineering drawings and reports;
- use mathematical and language skills effectively and apply technological systems and scientific principles to construct products that adhere to design specifications and meet quality control standards.

Specific Expectations

Organizational Skills

By the end of this course, students will:

– use effective brainstorming techniques to develop the best solution to a manufacturing challenge;

– use appropriate techniques to sketch solutions to scale showing orthographic and isometric views;

– use appropriate techniques to model and communicate product ideas, materials, and specifications;

– develop an operational plan for drawing procedures and production methods.

Technology and Production Skills

By the end of this course, students will:

– determine and convert drawing dimensions from metric units to imperial units, from imperial units to metric units, and from fractions to decimals so that the information corresponds to the demands of the particular manufacturing product or process;

– solve problems involving geometric calculations and algebraic equations; calculate perimeters, volumes, and area; and consult charts, tables, and reference books to determine the best manufacturing process;

– use the most appropriate material for a particular product by considering the intended use, customer specifications, quality control processes, and the environment that the product will be subjected to;

– explain the principles of dimensional metrology (precision measurement methods) and apply them to manufacturing processes;

– identify and use appropriate bench work techniques to lay out, fit, and assemble work pieces;

– read and interpret engineering drawings, visualize three-dimensional objects, sectionalize the drawings, and convert drawing dimensions;

– identify the appropriate machine or hand tools for specific tasks and then use them correctly and safely;

– maintain in good working order the machines and hand tools used in the production process;

– identify appropriate storage requirements for machine and hand tools used in the production process;

– use effectively a variety of power and control systems (e.g., pneumatic, hydraulic, and mechanical);

– program and use numerical control (NC) and computer numerical control (CNC) equipment.

Quality Control Skills

By the end of this course, students will:

- use a number of quality control processes when making products;
- design and use inventory and production control systems;
- use quality control methods (e.g., statistical process control) correctly and monitor the efficiency of the process using tools such as spreadsheets.

Communication Skills

By the end of this course, students will:

- produce process control charts that clearly outline the stages of the production process;
- prepare detailed working drawings and assembly drawings that depict the components of a product or process;
- develop a bill of material that indicates the specifications and quantity of a particular part of a product or process;
- conduct an accurate cost analysis of the final product or process;
- develop effective engineering drawings using a computer-aided drawing program;
- produce effective oral and written reports on the product or process.

Interdisciplinary Applications

By the end of this course, students will:

- apply mathematics (including algebra, geometry, and trigonometry) to work with integers, to order operations, to work with decimals and fractions, to make percent/decimal/fraction conversions, and to make imperial and metric conversions – all within the context of manufacturing design and production;
- apply scientific principles related to such areas as properties and states of matter, energy, force, Newton's laws of motion, simple machines, mechanical advantage, and basic electrical theory – all within the context of manufacturing design and production;
- use appropriate language in technical manuals, reports, and presentations.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- explain the environmental impact of using particular materials and processes when making products;
- identify pertinent legislation and practices related to safety;
- describe the career opportunities available in the manufacturing sector immediately on graduation;
- identify the employability skills required to be successful in the workplace;
- effectively implement safe work practices in the workplace.

Specific Expectations

Impacts

By the end of this course, students will:

– explain the importance of the proper disposal of waste products;

– explain the benefits of using environmentally friendly products in the manufacturing process.

Safety and Legislation

By the end of this course, students will:

– implement safe work practices (e.g., correct machine set-up, operational safety procedures) when performing tasks in the manufacturing process;

– use all required protective clothing and gear (e.g., for eye, ear, hand, head, foot, and respiratory protection);

– identify the specific components of the Occupational Health and Safety Act (OHSA) that relate to a manufacturing technology program;

– use material safety data sheets (MSDS) from the Workplace Hazardous Materials Information System (WHMIS) when handling materials.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify apprenticeship and training opportunities available in the manufacturing sector prior to or immediately following graduation, as well as their admission and training requirements;

– explain the important role that employability skills play in achieving success in the workplace.

Manufacturing Engineering Technology, Grade 12, College Preparation (TMJ4C)

This course focuses on advanced manufacturing and engineering, and provides students with an opportunity to develop specialized knowledge and skills used in sophisticated production processes. Students will solve problems; make the decisions necessary to develop a product for manufacture; and examine production methods, quality control systems, and environmental and societal impacts.

Prerequisite: Manufacturing Engineering Technology, Grade 11, College Preparation

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services in response to challenges or problems in manufacturing technology;
- describe the five major areas of a manufacturing process: research and development, production, marketing, industrial relations, and financial affairs;
- analyse and describe products and services in terms of their intended specifications, using the design process;
- describe how to optimize production systems by improving material flow, process layout, product layout, and quality control;
- explain the use of electronic, pneumatic, hydraulic, and mechanical control systems in the manufacturing process.

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how a human need or want can be met through a new or improved product;

– apply the following steps of the design process to solve a variety of manufacturing technology challenges or problems:
  □ identify what has to be accomplished (the problem);
  □ gather and record information, and establish a plan of procedures;
  □ brainstorm a list of as many solutions as possible;
  □ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
  □ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;
  □ produce presentation and working drawings, sketches, graphics, mathematical and physical models, or a prototype of the best solution;
  □ evaluate the prototype and determine the resources, including computer applications, required to produce it;
  □ communicate the solution, using one or more of the following: final drawings, graphs, charts, sketches, technical reports, electronic presentations, flow charts, mock-ups, models, prototypes, and so on;
  □ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Materials and Production Processes

By the end of this course, students will:

– explain the activities associated with research and development: discovery, development, and making specifications for improving products;

– describe the activities associated with marketing: identifying the potential market, promotion, sales, and distribution;

– explain the activities associated with industrial relations: recruiting, selecting, and training the work force;

– describe how a company conducts its financial affairs (i.e., how it raises and controls its money);

– use reverse engineering to explain existing products or processes in terms of function and cost;

- explain the use of a variety of electronic, pneumatic, hydraulic, mechanical, or computer control systems to control and automate projects and processes;
- explain how manufacturing systems and products are designed according to quality assurance standards;
- describe the three types of production systems: custom (e.g., "one-offs"), line production (e.g., assembly line), and continuous (e.g., automated);
- explain the factors associated with human costs (e.g., labour-intensive manufacturing, capital-intensive manufacturing, and the best use of unskilled, semiskilled, and skilled labour).

Skills and Processes

Overall Expectations

By the end of this course, students will:

- set up and function in an effective manufacturing enterprise;
- manage quality in a quality assurance program, using the three managerial processes – quality planning, quality control, and quality improvement;
- communicate effectively in the manufacturing sector using a variety of means;
- use mathematics and language skills and apply technological systems and scientific principles to design and fabricate a sophisticated product or manufacturing system.

Specific Expectations

Organizational Skills

By the end of this course, students will:

– set up a manufacturing enterprise, on a small scale or using a simulation, incorporating the five major areas of activity: research and development, production, marketing, industrial relations, and financial affairs;

– function in one or more areas of activity and execute the four typical functions of management – planning (setting goals and a course of action), organizing (structuring the job into manageable tasks), directing (assigning tasks and supervising their completion), and controlling (comparing results against the outlined plan) – to develop a product, on a small scale or using a simulation.

Technology and Production Skills

By the end of this course, students will:

– use computers to develop, operate, and control systems (e.g., for inventory or quality control);

– conduct pilot runs, analyse results, and modify operations, systems, and tooling as necessary;

– use bar coding and spreadsheets to monitor inventory;

– assemble power control and automation systems to meet the design criteria;

– choose suitable materials and processes for forming and fabricating products.

Quality Control Skills

By the end of this course, students will:

– develop products and processes required to meet customer needs using the following steps: determine who the customers are, determine their needs, design a product that responds to these needs, develop processes that can produce the product features, and transfer the resulting plans to the operating process;

– execute the following control steps: evaluate actual quality performance, compare actual performance to quality goals, and act on the differences;

– raise quality performance using the following steps: establish the infrastructure needed to secure quality improvement; identify specific areas for improvement; establish a project team with a clear responsibility for bringing the project to a successful conclusion; and provide the resources, motivation, and training that the team requires.

Communication Skills

By the end of this course, students will:

- develop an effective line organization chart of a student manufacturing enterprise in a school manufacturing facility;
- develop an appropriate flow chart for the major areas of activity in the student manufacturing enterprise;
- generate effective product specifications through engineering drawings, sketches, and reports;
- present an effective proposal related to the establishment of an enterprise.

Interdisciplinary Applications

By the end of this course, students will,

- apply mathematical skills in spreadsheet analysis to calculate production rates to close tolerances; to control inventory, costs, quality, and sampling; and to establish speeds;
- explain how science or scientific principles or practices are applied to material selection and specifications, energy consumption, worker fatigue, material processing, speed, force, and ergonomics;
- use language appropriately in flow charts, operations and inspections charts, job descriptions, lists of tooling requirements, quality-control program materials, worker training, formal presentations, and bills of material;
- apply the technological systems approach to their enterprise, taking each of the following into consideration: inputs – all the resources needed to accomplish the goals of the system (e.g., people, knowledge, materials, energy, finance, capital); process – the scheme of purposeful actions and practices that make up the technical aspects of the system; outputs – the goal or ends to which all inputs and processes are applied; and feedback – the mechanisms that provide preferred direction for the system.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- demonstrate the knowledge required to make informed decisions concerning the social, environmental, and economic consequences and impact of the manufacturing sector;
- evaluate and implement safe work practices in performing manufacturing-related tasks;
- identify the role of health and safety legislation in manufacturing technology programs in schools and in the manufacturing sector;
- describe the postsecondary programs associated with the manufacturing sector and evaluate the appropriateness of the programs to their career plans.

Specific Expectations

Impacts

By the end of this course, students will:

– identify potential consequences of specific manufacturing activities for the individual and for society, and formulate potential alternatives to minimize harmful consequences;

– describe the negative impact of manufacturing activities on the environment and identify a variety of materials, processes, and waste management methods to reduce that impact;

– explain the economic impact of the manufacturing sector for the local community, the province, and the nation.

Safety and Legislation

By the end of this course, students will:

– use safe work practices and model the most appropriate method for a particular operation;

– develop and conduct safety audits and inspections of the school manufacturing facility and implement a plan to address any deficiencies;

– develop an effective emergency action plan for the school manufacturing facility;

– analyse the Occupational Health and Safety Act (OHSA) and implement the parts of it that relate specifically to the school manufacturing facility;

– identify the issues addressed in the Workplace Hazardous Materials Information System (WHMIS).

Education, Training, and Career Opportunities

By the end of this course, students will:

– demonstrate a knowledge of career activities within the manufacturing sector (e.g., management, marketing, finance, production, quality control, engineering);

– demonstrate a knowledge of postsecondary programs associated with the manufacturing sector and evaluate the appropriateness of the programs to their career plans;

– demonstrate an understanding of their own strengths and limitations in preparation for careers in the manufacturing sector.

Manufacturing Technology, Grade 12, Workplace Preparation (TMJ4E)

This course focuses on drafting and design, machining, welding, computer numerical control (CNC), computer-assisted machining (CAM), motor control, hydraulic control, pneumatic control, and computer control. Students will use sophisticated design and manufacturing systems to design and fabricate tooling, to program CNC equipment, and to design and build solutions to technological challenges in manufacturing.

Prerequisite: Manufacturing Technology, Grade 11, Workplace Preparation

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services in response to challenges or problems in manufacturing technology;
- interpret engineering drawings, specifications, and related materials when determining and planning a manufacturing process;
- identify the tools, materials, processes, and technical concepts involved in the manufacture of a product or the development of a production process.

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how a human need or want can be met through a new or improved product;

– apply the following steps of the design process to solve a variety of manufacturing technology problems:
  □ identify what has to be accomplished (the problem);
  □ gather and record information, and establish a plan of procedures;
  □ brainstorm a list of as many solutions as possible;
  □ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
  □ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;
  □ produce presentation and working drawings, sketches, graphics, mathematical and physical models, or a prototype of the best solution;
  □ evaluate the prototype and determine the resources, including computer applications, required to produce it;
  □ communicate the solution, using one or more of the following: final drawings, graphs, charts, sketches, technical reports, electronic presentations, flow charts, mock-ups, models, prototypes, and so on;
  □ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution;

– interpret and work with engineering drawings, appropriate reference materials, conversion charts and tables, and material- and product-related specifications when determining and planning a manufacturing process.

Materials and Production Processes

By the end of this course, students will:

– analyse the properties of materials in terms of functionality, cost effectiveness, customer expectations, and availability;

– select tools, machinery, materials, and processes that best accommodate production runs;

– describe the factors that affect material selection, including the properties of the material, the projected applications for the material, and the forces that will be exerted on the material.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- work as effective members of a team;
- use current technology and a variety of manufacturing processes to meet product specifications;
- produce products or services that adhere to quality control standards;
- use effective communication techniques to work with others and to communicate product ideas, materials, and specifications;
- use mathematical and language skills effectively and apply technological systems and scientific principles to design and fabricate tooling and to build solutions to a variety of manufacturing challenges.

Specific Expectations

Organizational Skills

By the end of this course, students will:

– demonstrate the following skills: accepting responsibility, delegating tasks when appropriate, using effective communication and conflict resolution skills and effective time management and goal-setting techniques;

– develop bills of material and plans of operation to communicate satisfactorily the production materials used and the methods and order of operations.

Technology and Production Skills

By the end of this course, students will:

– use the following processes effectively: casting and moulding, conditioning (e.g., metal treatment), coating and plating, separating (e.g., cutting), forming, assembling, and finishing;

– program and use numerical control (NC) and computer numerical control (CNC) equipment;

– use current technology and production skills safely in the development of a product or process (e.g., saws, drills, lathes, mills, planers, jointers, grinders, NC, CNC);

– lay out patterns to minimize waste of materials;

– identify, select, and use the most appropriate tools, machines, and processes when fabricating a product or process;

– maintain in good order machines and hand tools used in the production process;

– design and produce appropriate storage systems for hand and machine tools;

– modify and adapt machine tools safely to allow for a variety of uses;

– install the power and control systems required by project specifications.

Quality Control Skills

By the end of this course, students will:

– inspect incoming materials, monitor production processes, and inspect finished products;

– select and use measurement instruments and checking devices to ensure accuracy;

– conduct a final inspection process and report thoroughly on the attributes of the product with reference to industry standards;

– design and use inventory and production control systems;
– explain the data from statistical process control (SPC) systems and adjust the production process accordingly.

Communication Skills

By the end of this course, students will:

– communicate product specifications effectively through engineering drawings;
– create and interpret detailed working drawings using computer-assisted design programs (CAD) and computer-assisted machining programs (CAM);
– communicate clearly to identify order of operations; availability of tools, parts, and equipment; scheduling requirements; and other information needed to plan and prepare for the fabrication process;
– develop and present effective written and oral reports on products and production methods;
– produce appropriate production flow charts for managing product design and fabrication.

Interdisciplinary Applications

By the end of this course, students will:

– demonstrate an ability, in the context of manufacturing design and production, to perform geometric calculations and functions; to calculate perimeters, areas, and volumes; to convert drawing dimensions from metric to imperial units of measurement; and to interpret and use charts and tables effectively.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- evaluate any negative environmental impact of specific products and processes and recommend alternative methods and materials to reduce the impact;
- develop and conduct safety audits and inspections of the school manufacturing facility and implement a plan to address any deficiencies;
- describe the Occupational Health and Safety Act (OHSA) and identify its implications for the school manufacturing facility and for their workplace;
- identify the career opportunities available through apprenticeships or other training programs and assess their own aptitude for such opportunities;
- demonstrate the employability skills required for success in the workplace.

Specific Expectations

Impacts

By the end of this course, students will:

– evaluate any negative impact of the manufacturing process on the environment and suggest environmentally friendly alternatives that could be substituted for existing materials or manufacturing methods;

– recommend an effective process for collecting and recycling materials and fluids;

– handle waste products effectively and be able to implement an emergency action plan in the event of a minor spill.

Safety and Legislation

By the end of this course, students will:

– use safe work practices in the manufacturing program;

– demonstrate good housekeeping practices in the work environment by cleaning up spills and leaks, keeping areas clean and clear of obstructions, and sorting tools and equipment so that the potential for an accident or injury is minimized;

– develop comprehensive safety checklists for machine tools and operations;

– use all required protective clothing and gear (e.g., eye, ear, hand, head, foot, and respiratory protectors);

– identify components of the Occupational Health and Safety Act (OHSA) that relate to specific machine tools and operations used in the school manufacturing facility.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify the wide range of career opportunities available in the manufacturing sector;

– identify the training required to enter apprenticeships for different careers in the manufacturing sector;

– describe the employability skills identified by the Conference Board of Canada.

Technological Design

Overview

To look at a skyscraper, a powerful automobile, a robotic assembly line, or a bridge linking two shores is to see the work of a technical designer. A designer's role is to apply knowledge of materials, mathematics, trends, and fabrication methods to formulate or innovate products, services, and methods. The technologies and processes used to create design solutions may include both traditional and computer-based drawing methods and models, animations and simulations, and displays.

Technological design education focuses on the practical application of the principles of design, engineering, and architecture to promote solutions to challenges in communications, manufacturing, electronics, transportation, and architecture. Students will develop the analytic skills required to determine user needs, to generate many solutions, and to select the most suitable one. They will also acquire the communication skills needed to present the solution in the form of technical drawings, models, reports, and displays; the technical skills required to perform engineering and scientific tests and analyses; and the evaluation skills needed to compare the chosen solution to the original problem.

For essential information on policy regarding multiple-credit courses and courses with particular areas of emphasis, see pages 6-7 of this document.

Note: Furniture design can be included as one of the areas of application in technological design courses.

Technological Design, Grade 11, University/College Preparation (TDJ3M)

This course provides students with opportunities to apply the principles of technological design to challenges in communications, manufacturing, electronics, transportation, architecture, industrial and consumer products, health and safety equipment, and environmental services. Students will identify user needs, estimate labour and material costs, analyse material characteristics, and illustrate design solutions, using traditional and computer-based methods. They will also acquire the basic design skills required for postsecondary studies in engineering, manufacturing, architecture, and construction.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- use the design process to create products or services based on an analysis of consumer needs and market requirements;
- follow Canadian Standards Association (CSA) drawing practices (e.g., using standardized symbols; orthographic projection; and applicable codes such as the Ontario Building Code, the Electrical Safety Code, and municipal by-laws) when creating drawings;
- describe manufacturing and construction processes used in industry;
- describe the significance of the components contained in a technical report;
- determine project criteria and evaluate solutions to decide how well the criteria have been met.

Specific Expectations

Planning

By the end of this course, students will:

– evaluate consumer needs and expectations in relation to a specific product;

– evaluate the suitability of materials to meet the project criteria based on the materials' properties and costs, and on the manufacturing methods being used;

– describe manufacturing processes used in engineering;

– describe construction processes used in architectural technology.

Preparing Designs

By the end of this course, students will:

– apply the design process to develop solutions for a particular product or service;

– create technical drawings that reflect appropriate line type, weight, and density;

– use technical illustrations, drafting, computer graphics, and models to present ideas and solutions.

Evaluating and Documenting Designs

By the end of this course, students will:

– identify, in technical reports, factors (e.g., materials, fabrication methods, trends, costs, ergonomics, alternative solutions) that influence design decisions for a particular product;

– evaluate solutions to ensure that project criteria are met.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- follow drafting conventions to produce technical drawings;
- analyse the physical characteristics of common building and manufacturing materials proposed for a design solution;
- produce technical reports and design briefs that follow a prescribed format;
- estimate the materials, fabrication, and labour costs associated with a project;
- build effective models and prototypes.

Specific Expectations

Planning

By the end of this course, students will:

– create effective design briefs that outline consumer needs and any other requirements or limitations that will affect the design solution;

– produce technical reports that follow a prescribed format;

– identify materials for particular projects based on desired physical properties using technical reference material such as *Machinery's Handbook*, *Sweet's Catalogue*, or *Architectural Graphics Standards*;

– determine whether proposed materials are suitable for a specific product;

– write effective technical reports that include sections such as the following: Design Brief, Criteria and Constraints, Idea Development, Planning, Design Analysis, Evaluation, Design Solution, Product Description.

Preparing Designs

By the end of this course, students will:

– create accurate drawings (e.g., floor plans, perspectives and elevation views, section and assembly drawings) using both traditional (drafting board) and computer-based methods;

– estimate the costs of materials and fabrication methods for particular projects by performing quantity take-offs;

– fabricate models and prototypes following standard safety procedures.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- identify concerns related to technical design, such as product safety, durability, costs, choice of materials, and ergonomics;
- identify actions that can be taken in response to environmental concerns;
- describe liability issues that necessitate the inclusion of safety features in a product's design;
- follow safe operating procedures for tools and materials;
- identify a variety of careers in engineering, architecture, or industrial design and the educational requirements for each.

Specific Expectations

Design Impacts

By the end of this course, students will:

– describe problems caused by improper or inadequate design;

– identify existing products that could be improved and explain problems in these products that resulted from inadequate design.

Environmental and Safety Issues

By the end of this course, students will:

– explain different methods of handling materials and waste generated by the construction or manufacturing industries;

– describe safety issues, constraints, or legislation that would affect the design of a particular project and explain how these restrictions would affect design documentation and drawings;

– handle materials and tools safely.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify a variety of careers in engineering, architecture, or industrial design;

– identify the educational and other requirements for a career in engineering or architecture that is related to technological design.

Technological Design, Grade 11, Workplace Preparation (TDJ3E)

This course provides students with opportunities to apply the principles of basic design to technological challenges in industry, engineering, architecture, manufacturing, and graphics. Students will develop problem-solving and design skills through the use of technical drawings and illustrations, model building, testing, and marketing. They will also become aware of consumer, business, and environmental issues in the creation and marketing of products or services, and the educational requirements of design-related careers.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- demonstrate an understanding of how the design process is used to create products or services for the marketplace;
- create effective technical drawings using standardized drawing practices;
- determine appropriate solutions to design problems;
- describe manufacturing and construction materials and techniques related to their projects;
- write effective technical reports that follow a conventional format.

Specific Expectations

Planning

By the end of this course, students will:

– describe user requirements, design criteria, and ways of developing and testing solutions;

– justify design decisions that involve alternative approaches;

– describe the historical development of a variety of designed products and services.

Preparing Designs

By the end of this course, students will:

– use technical illustrations, drafting, computer graphics, and models to present ideas and solutions effectively;

– describe materials that are appropriate for the manufacture or construction of given projects;

– describe appropriate methods of manufacture or construction for given projects.

Evaluating and Documenting Designs

By the end of this course, students will:

– write reports summarizing how the criteria and constraints influenced a particular design decision;

– evaluate solutions based on given design criteria.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- illustrate their design solutions effectively using a variety of technical drawing methods that conform to industry drafting conventions;
- fabricate projects or displays using hand and power tools safely;
- write effective design briefs and technical reports;
- evaluate solutions against design criteria.

Specific Expectations

Preparing Designs

By the end of this course, students will:

– draw appropriate technical illustrations using industry-standard practices, including lettering techniques, scales, and symbols;

– produce correct orthographic or pictorial technical drawings (e.g., floor plans, perspectives and elevation views, section and assembly drawings) using traditional or computer-based methods;

– fabricate models and prototypes for analysis and testing using standard safety procedures;

– create displays of the finished products using computer graphics, posters, or multimedia productions.

Evaluating and Documenting Designs

By the end of this course, students will:

– produce appropriate design briefs based on their analysis of user needs and on consumer product research;

– prepare technical reports documenting the design process and proposed solution;

– evaluate design solutions to determine how well they suit the design criteria.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- identify factors that must be considered when designing for the consumer marketplace (e.g., costs, materials, safety, durability);
- identify environmental concerns related to the development, use, and disposal of manufactured goods;
- use tools and materials safely to fabricate products;
- describe design-related careers and their educational requirements.

Specific Expectations

Design Impacts

By the end of this course, students will:

– assess project solutions in terms of safety, ergonomics, and efficiency;

– identify design issues, such as production costs, instructional materials for assembly and use, special design needs related to controls and instrumentation, safety issues in handling products, and product durability;

– describe problems that can result from improper design.

Environmental and Safety Issues

By the end of this course, students will:

– identify alternative environmentally friendly materials that could be used to produce specific products;

– explain various methods of handling materials and reducing waste;

– handle tools and materials safely.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify a variety of design-related careers;

– identify the educational and training requirements for careers related to technological design.

Technological Design, Grade 12, University/College Preparation (TDJ4M)

This course provides students with opportunities to solve problems in design through the use of technical drawings, model building, testing, and marketing. Students will research, design, and test solutions for residential or commercial architecture, industrial engineering, and manufacturing. They will also examine the educational requirements of a technical design–related career in engineering, architecture, or industrial design.

Prerequisite: Technological Design, Grade 11, University/College Preparation

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply engineering principles and appropriate formulas to design work;
- demonstrate the ability to interpret technical reference materials and test data;
- describe manufacturing or construction techniques used in architecture, engineering, or industrial design;
- solve engineering problems in a team environment;
- identify suitable ways of communicating their design ideas.

Specific Expectations

Planning

By the end of this course, students will:

– explain the engineering principles that apply and the formulas used in technological design (e.g., related to the strength of materials, static and dynamic formulas, bending moments, shear);

– describe how engineering principles apply to methods of structural testing;

– demonstrate an ability to consult pertinent technical reference materials (e.g., trade literature, catalogues, and applicable codes such as the Ontario Building Code, the Electrical Safety Code, and municipal by-laws) as required by the project.

Preparing Designs

By the end of this course, students will:

– prepare accurate mechanical and industrial engineering drawings (e.g., detail and assembly drawings);

– describe the sequence of construction used in frame construction and identify the related trades (e.g., electricians, carpenters, masons, heating and air-conditioning installers) used in the construction industry;

– work cooperatively in a group, communicating ideas effectively, being supportive of other group members' ideas, and accepting constructive criticism;

– use technical illustrations, traditional or computer-aided drawing methods, and models to present ideas and solutions effectively.

Evaluating and Documenting Designs

By the end of this course, students will:

– keep accurate records of engineering tests and results;

– assess the different methods of illustrating a design solution (e.g., by using engineering drawings, models, or prototypes) and choose the most suitable for each project;

– write technical reports detailing product specifications, test results, and effectiveness in meeting established design criteria.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- produce effective design briefs and technical reports, and create freehand illustrations and traditional or computer-aided drawings that conform to industry standards;
- fabricate effective models and displays of student-developed products;
- perform structural and material tests correctly;
- estimate the cost of labour and materials for a project;
- evaluate project solutions.

Specific Expectations

Planning

By the end of this course, students will:

– prepare effective design briefs outlining problems that require design solutions;

– include appropriate health and safety codes in project documentation;

– use either traditional (drafting board) or computer-based methods to create industry-standard drawings (e.g., three-dimensional projections, working drawings, floor plans, perspectives and elevation views, details, auxiliaries, section and assembly drawings).

Preparing Designs

By the end of this course, students will:

– construct functional models and prototypes of their finished products;

– create effective displays and presentations of their finished products;

– conduct appropriate structural tests on components and assemblies;

– conduct appropriate tests to determine the properties of materials;

– estimate the costs of project materials and labour.

Evaluating and Documenting Designs

By the end of this course, students will:

– prepare effective technical reports documenting the design process and proposed solutions;

– evaluate the appropriateness of project solutions in terms of the design criteria;

– evaluate the suitability of materials for project design applications.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- identify ethical issues related to engineering design;
- handle materials and tools safely;
- assess project solutions in terms of safety, efficiency, ergonomics, and the environment;
- describe careers in engineering, architecture, or industrial design and the educational requirements for each.

Specific Expectations

Design Impacts

By the end of this course, students will:

– identify design considerations when designing for the physically challenged (e.g., accessibility and function);

– explain ethical issues related to design engineering (e.g., those outlined in professional charters).

Environmental and Safety Issues

By the end of this course, students will:

– handle tools and materials safely;

– analyse the consequences of a product's features in terms of safety, efficiency, ergonomics, and the environment;

– describe how well-designed project solutions can minimize negative environmental impact.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify career opportunities in architecture, engineering, or industrial design that are related to technological design;

– describe the requirements and educational qualifications for the career opportunities identified.

Technological Design, Grade 12, Workplace Preparation (TDJ4E)

This course helps students develop a systematic process to design products or services based on an understanding and analysis of consumer needs, material characteristics, fabrication methods, and design principles. Students will develop design briefs, conduct marketing surveys, create freehand and computer-generated illustrations, make models, generate technical reports, design packaging, and become aware of design trends. They will also examine careers and small business opportunities in design, architecture, manufacturing, or marketing.

Prerequisite: Technological Design, Grade 11, Workplace Preparation

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- demonstrate an understanding of how the design process is used to create products or services for the marketplace;
- evaluate the suitability of materials and methods of fabrication for a variety of products;
- explain the principles and fundamentals of design;
- consult appropriate technical reference materials for specific projects and services.

Specific Expectations

Planning

By the end of this course, students will:

– plan an appropriate marketing survey for a particular product or service;

– analyse the results of a marketing survey to determine consumer needs and requirements;

– explain how to develop a needs analysis based on research into consumer products or services;

– assess a variety of materials and fabrication techniques used for different custom and mass-manufactured products.

Preparing Designs

By the end of this course, students will:

– use the principles of symmetrical and asymmetrical balance, rhythm, repetition, and spatial proportions when creating models and illustrations;

– use the fundamentals of line and direction, pattern, light and shadow, shape and space, texture, and colour when creating models and illustrations;

– demonstrate an ability to consult reference materials such as codes, *Machinery's Handbook*, *Sweet's Catalogue*, *Architectural Graphic Standards*, and trade literature and catalogues.

Evaluating and Documenting Designs

By the end of this course, students will:

– explain project designs in terms of satisfying consumer needs and meeting design criteria;

– identify design constraints for specific projects.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- produce effective design briefs outlining the design challenges they face and the design criteria they will use to meet the challenges;
- estimate the costs of projects;
- prepare effective models, prototypes, and finished products;
- create appropriate drawings using either traditional or computer-based methods;
- prepare appropriate promotional materials and write effective technical reports for the products they create.

Specific Expectations

Planning

By the end of this course, students will:

– identify design problems, list relevant criteria, and propose solutions;

– produce effective design briefs that include analyses of consumer needs, design criteria, and considerations in meeting design challenges;

– estimate the costs of project materials and labour;

– identify appropriate materials for models and finished products by analysing material characteristics and properties.

Preparing Designs

By the end of this course, students will:

– prepare effective technical drawings using standard scales, lettering techniques, and symbols;

– use computer-aided design methods effectively to produce illustrations (e.g., floor plans, perspectives and elevation views, details, auxiliaries, and assembly drawings) as required;

– illustrate design solutions effectively using orthographic and pictorial techniques;

– build effective displays and product prototypes.

Evaluating and Documenting Designs

By the end of this course, students will:

– evaluate the appropriateness of project solutions against design criteria;

– design promotional materials that are suitable for potential clients or investors;

– prepare technical reports documenting the design process, needs analyses, comparisons of existing solutions, and testing and evaluation procedures.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe safety features and ethical issues that must be addressed in technological design;
- describe problems caused by improper or inadequate design;
- handle the tools and equipment used in technological design safely;
- identify career opportunities in design-related businesses;
- identify the requirements for joining a professional association.

Specific Expectations

Design Impacts

By the end of this course, students will:

– describe how project solutions address efficiency and ergonomic issues, comparing proposed products or services to existing ones;

– identify how existing products could be improved to address problems that result from improper or inadequate design.

Environmental and Safety Issues

By the end of this course, students will:

– handle tools and materials safely;

– explain how project solutions affect the environment;

– evaluate the procedures used in processing materials, taking into consideration safety issues and environmental concerns;

– identify the environmental concerns related to a product's life.

Education, Training, and Career Opportunities

By the end of this course, students will:

– identify career opportunities in design, architecture, or manufacturing;

– describe the educational qualifications required for the career opportunities identified;

– identify the requirements for joining a professional association and describe the association's code of ethics.

Transportation Technology

Overview

Transportation affects our lives in a multitude of ways. We use cars for everyday purposes, mass transit to commute to work, and flights and cruises for holidays. Transportation systems move raw materials to manufacturers and finished products to consumers locally, nationally, and globally.

Transportation technology courses provide students with opportunities to acquire the knowledge and skills needed to service, repair, and modify vehicles and vehicle systems. Student will also learn about the organization and management of transportation services and mass-transit systems.

For essential information on policy regarding multiple-credit courses and courses with particular areas of emphasis, see pages 6-7 of this document.

Transportation Technology, Grade 11, College Preparation (TTJ3C)

This course examines the infrastructure required for the operation of land, air, and/or marine vehicles. Students will design, construct, and modify vehicles, and apply safe work practices and procedures using current technology. They will also develop effective communication and teamwork skills when developing solutions to managing vehicle support systems; investigate the educational requirements for career opportunities in the transportation sector; and analyse the impact of transportation technology on society and the environment.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services in response to challenges or problems in transportation technology;
- describe how materials and processes are used to produce solutions to meet human needs and wants related to transportation;
- identify the impact of the movement of people and goods on vehicle systems and modes of transportation (highway, rail, air, water, pipeline);
- describe the forms of energy used to power vehicles and transportation systems and explain the different types of energy conversion used for each.

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how human needs or wants related to transportation can be met through a new or improved vehicle or system;

– apply the following steps of the design process to solve a variety of transportation technology challenges or problems:
  □ identify what has to be accomplished (the problem);
  □ gather and record information, and establish a plan of procedures;
  □ brainstorm a list of as many solutions as possible;
  □ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
  □ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;
  □ produce presentation and working drawings, sketches, graphics, mathematical and physical models, or a prototype of the best solution;
  □ evaluate the prototype and determine the resources, including computer applications, required to produce it;
  □ communicate the solution, using one or more of the following: final drawings, graphs, charts, sketches, technical reports, electronic presentations, flow charts, mock-ups, models, prototypes, and so on;
  □ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Transportation Systems

By the end of this course, students will:

– describe the importance of transportation systems to maintaining our quality of life;

– explain how people and goods are moved by highway, air, rail, water, and pipeline transportation systems;

– describe the importance of distance, weight, and volume when selecting the most cost-efficient means of transporting goods;

– explain how comfort and speed relate to the selection of the most cost-efficient means of transporting people.

Energy and Energy Conversion

By the end of this course, students will:

– explain the difference between internal and external combustion engines;

– describe the conversion of energy in reciprocating, rotary, rotor, and turbine engines, and the use of linear motion in vehicle engines and motors;

– describe and evaluate the conversion of an energy source into power in piston, rotary, and jet engines.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- design and produce models of different mass-transit systems that indicate the advantages and disadvantages of each system;
- use current technology and procedures to service and repair vehicles and transportation systems;
- use a variety of communication techniques to model and communicate product ideas, materials, and specifications;
- use mathematical and language skills and apply technological and scientific principles in the design, construction, and modification of vehicles and infrastructure for various modes of transportation.

Specific Expectations

Organizational Skills

By the end of this course, students will:

– develop systems for production, marketing, personnel, and financial control related to transportation systems;

– use computers to help develop, operate, and control transportation systems;

– sketch appropriate solutions to defined problems to scale showing orthographic and isometric views;

– use fabrication techniques to mock up or model potential solutions to a transportation technology challenge;

– test materials and products to develop the best solution to a transportation technology challenge;

– select and use appropriate software to develop marketing strategies for a solution to a transportation technology challenge.

Applied Work Practices and Procedures

By the end of this course, students will:

– select and use a wide variety of hand and machine tool procedures to repair, service, fabricate, and modify a vehicle or a transportation system;

– measure electrical flow, weight, capacity, length, area, volume, and pressure when diagnosing problems in vehicles and transportation systems;

– design and implement an inventory control system for a vehicle service facility;

– plan, organize, direct, and operate a vehicle service facility and evaluate the facility's efficiency;

– recommend appropriate modifications to specific operations of a vehicle service facility.

Communication Skills

By the end of this course, students will:

– interpret assembly drawings to identify and describe the components of a vehicle or a transportation system;
– develop an accurate bill of material that indicates the specifications and quantity requirements of specific parts of a vehicle or a transportation system;
– develop effective engineering drawings using a computer-aided drafting program to solve challenges in vehicles and transportation systems;
– produce engineering reports that clearly communicate the specifics of a service or a repair;
– prepare and present effective oral reports about a product or process.

Interdisciplinary Applications

By the end of this course, students will:

– apply mathematical skills in spreadsheet analysis to measure to close tolerances and to control inventory, sampling, costs, and quality;
– apply appropriate scientific principles or practices when selecting and specifying materials, determining forms of energy conversion and power transfer, and designing ergonomically effective vehicles;
– use appropriate language in flow charts, operation and inspection charts, job descriptions, lists of tooling requirements, or quality-control programs.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- make informed decisions that take into consideration the social and environmental consequences related to the transportation sector;
- describe, and apply where appropriate, the exemplary practices that are essential to safe work environments and practices;
- describe the role of health and safety legislation related to the transportation sector and to transportation technology programs in schools;
- describe the postsecondary and career opportunities available in the transportation sector following graduation from a college program.

Specific Expectations

Impacts

By the end of this course, students will:

– describe the consequences of transportation technology for individuals and for society (e.g., by conducting a survey to document how an efficient mass-transit system affects the travel time for a commuter, or by investigating the demographics of commuting and identifying whether the current mass-transit system in their region could handle the anticipated population growth over the next five years);

– describe the possible impact of transportation technology on the environment;

– identify a variety of materials, processes, and waste-management methods that would minimize the negative impact of a transportation-related activity.

Safety and Legislation

By the end of this course, students will:

– apply safe work practices when performing transportation-related processes;

– identify potential hazards in a workplace related to the transportation sector by conducting safety audits and inspections;

– describe specific components of the Occupational Health and Safety Act (OHSA) related to transportation technology and the actions required to adhere to the act;

– explain the use of the Workplace Hazardous Materials Information System (WHMIS) and the importance of consulting material safety data sheets (MSDS) whenever appropriate;

– recognize the meaning of the hazard labels associated with WHMIS;

– describe and evaluate the legislation pertinent to land, air, and marine vehicles, as well as to working conditions and practices (e.g., legislation regulating such things as emission testing, minimum fuel economy standards, safety specifications, and minimum crash test standards).

Education, Training, and Career Opportunities

By the end of this course, students will:

– describe the scope of career opportunities in the transportation sector;

– identify specific educational and training requirements for careers in the transportation sector;

– describe career programs related to the transportation sector such as cooperative education and Ontario Youth Apprenticeship Programs (OYAP);

– explain the differences in the roles of technicians, technologists, and engineers, and the educational requirements for each.

Transportation Technology, Grade 11, Workplace Preparation (TTJ3E)

This course examines the various types of land, air, and/or marine vehicles and vehicle systems found within the transportation sector. Students will acquire identification, troubleshooting, repairing, and testing skills that meet industry standards and government regulations. In addition to developing employability and technical skills, they will explore the broad range of career opportunities within this sector, and will examine the impact of the transportation sector on people, society, and the environment.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services in response to challenges or problems in transportation technology;
- explain the use of each component of a vehicle system;
- analyse and describe the interrelationships of vehicle systems;
- describe and evaluate the fuels used to power vehicles.

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how human needs or wants related to transportation can be met through a new or improved vehicle or system;

– apply the following steps of the design process to solve a variety of transportation technology challenges or problems:
  □ identify what has to be accomplished (the problem);
  □ gather and record information, and establish a plan of procedures;
  □ brainstorm a list of as many solutions as possible;
  □ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
  □ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;
  □ produce presentation and working drawings, sketches, graphics, mathematical and physical models, or a prototype of the best solution;
  □ evaluate the prototype and determine the resources, including computer applications, required to produce it;
  □ communicate the solution, using one or more of the following: final drawings, graphs, charts, sketches, technical reports, electronic presentations, flow charts, mock-ups, models, prototypes, and so on;
  □ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Vehicle Systems

By the end of this course, students will:

– analyse and describe the use of each of the following components of a vehicle: the chassis, frame, and body; the engine system; the fuel system; the electrical/electronics system; the gear and power train system; the steering system; the brake system; and the suspension system;

– explain the interrelationship of these vehicle components.

Energy and Energy Conversion

– explain the types and grades of fuel used in land, air, and marine vehicles;

– analyse and describe the energy values of different types and grades of fuels.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- function effectively both as individuals and as members of a cooperative team to service and repair vehicles;
- apply the technological principles of input, process, and output in troubleshooting vehicle systems;
- use current technology (e.g., on-line information from manufacturers, CD-ROM manuals, computerized diagnostic tools) when servicing, repairing, and modifying vehicles;
- communicate clearly about transportation techniques and applications using appropriate transportation terms;
- use mathematical and language skills effectively and apply scientific principles to help solve transportation technology challenges.

Specific Expectations

Organizational Skills

By the end of this course, students will:

– use brainstorming techniques to help determine the best solution to a transportation-related challenge;

– model and communicate product ideas, materials, and specifications;

– describe the individual roles of members of an effective cooperative team and explain how team members function within these roles;

– develop a plan of procedures that indicates the steps required when repairing or servicing a vehicle;

– complete a work order for a specific transportation technology task.

Applied Work Practices and Procedures

By the end of this course, students will:

– use effectively, store safely, and maintain in good working order measurement, hand, power, machine, and pneumatic tools and equipment required for basic service tasks;

– operate a variety of heating, cutting, and welding equipment for basic service tasks;

– systematically troubleshoot basic service problems on vehicles by organizing the variables into the following categories: input, process, and output;

– access and apply information from manuals, software databases, on-line information, and computerized diagnostic tools when troubleshooting and repairing components.

Communication Skills

By the end of this course, students will:

– correctly interpret assembly drawings that depict the components of a vehicle's systems;

– conduct an accurate cost analysis of a repair or service and communicate the results of the analysis to a customer;

– produce oral, written, and word-processed reports of repairs or services.

Interdisciplinary Applications

By the end of this course, students will:

– use mathematics to calculate volume, ratios, and dimensions;

– apply correctly, within the context of transportation technology, the scientific principles related to such areas as properties and states of matter, energy, force, Newton's laws of motion, simple machines, mechanical advantage, and basic electrical theory;

– use appropriate technical language in technical reports and presentations.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- explain the environmental impact of materials and procedures used when servicing, repairing, and recycling vehicles;
- follow safe work practices in the transportation sector workplace, including safety procedures and practices and the use of protective clothing and gear;
- identify the legislation that applies to the transportation technology sector;
- describe the career opportunities available in the transportation sector on graduation from high school;
- describe and evaluate the employability skills required to be successful in the workplace.

Specific Expectations

Impacts

By the end of this course, students will:

– explain the importance of the proper disposal of waste products;

– explain the benefits of using environmentally friendly products in the repair and service of vehicles.

Safety and Legislation

By the end of this course, students will:

– work safely when performing tasks in the transportation sector;

– use all required protective clothing and gear (e.g., to protect the eyes, ears, hands, head, feet, and respiratory system) when working in the transportation sector;

– identify which aspects of the Occupational Health and Safety Act (OHSA), the Workplace Hazardous Materials Information System (WHMIS), and the Motor Vehicle Repair Act relate specifically to a transportation technology program;

– use material safety data sheets (MSDS) from the WHMIS when handling materials;

– describe the Motor Vehicle Repair Act and explain how it affects a transportation technology program.

Education, Training, and Career Opportunities

By the end of this course, students will:

– describe apprenticeship and training opportunities in the transportation sector before and after graduation from high school;

– explain the importance of employability skills in achieving success in the workplace.

Transportation Technology, Grade 12, College Preparation (TTJ4C)

This course examines alternative modes of mass transit to enable students to develop the specialized knowledge and skills required to work with sophisticated land, air, and/or marine vehicles and transportation systems. Students will solve problems related to vehicles and transportation systems; examine transportation-related issues such as energy conversion, power transfer, control systems, and environmental and societal impact; and investigate the educational requirements of career opportunities in the transportation sector.

Prerequisite: Transportation Technology, Grade 11, College Preparation

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services in reponse to challenges or problems related to vehicles or vehicle systems;
- identify different forms of mass transit and explain how they interrelate with each other;
- analyse and describe the kinds and costs of different forms of energy conversion used in the transportation of people and goods using land, air, and marine vehicles;
- research sources of energy and power transmission that could be used to fuel vehicles and transportation systems in the future.

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how human needs or wants related to transportation can be met through a new or improved vehicle or vehicle system;

– apply the following steps of the design process to solve a variety of transportation technology challenges or problems:
  □ identify what has to be accomplished (the problem);
  □ gather and record information, and establish a plan of procedures;
  □ brainstorm a list of as many solutions as possible;
  □ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
  □ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;
  □ produce presentation and working drawings, sketches, graphics, mathematical and physical models, or a prototype of the best solution;
  □ evaluate the prototype and determine the resources, including computer applications, required to produce it;
  □ communicate the solution, using one or more of the following: final drawings, graphs, charts, sketches, technical reports, electronic presentations, flow charts, mock-ups, models, prototypes, and so on;
  □ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Transportation Systems

By the end of this course, students will:

– evaluate and compare the efficiency, capacity, and convenience of a variety of different mass-transit systems;

– describe the need for coordination among the different forms of mass transit;

– identify the infrastructure requirements of an efficient mass-transit system.

Energy and Energy Conversion

By the end of this course, students will:

– describe a variety of energy sources and investigate the availability of future energy sources;

– analyse the requirements of converting various types of energy into power in terms of such things as the equipment required, efficiency, and costs;

- describe the different forms of energy required to power mass-transit systems after analysing their power output, accessibility, abundance, environmental impact, cost, and conversion efficiency;
- explain the by-products produced by the conversion of a variety of energy sources;
- analyse and describe the power requirements of different vehicles and the energy source of each and its transmission method.

Skills and Processes

Overall Expectations

By the end of this course students will:

- apply effective work practices and procedures as part of a team when developing models of mass-transit systems;
- develop and operate models of effective mass-transit systems;
- communicate effectively regarding the transportation sector using a variety of means;
- use mathematical and language skills effectively and apply technological and scientific principles to solve vehicle and mass-transit challenges.

Specific Expectations

Organizational Skills

By the end of this course, students will:

– design a mass-transit enterprise incorporating the five major areas of activity: research and development, production, marketing, industrial relations, and financial affairs;

– function effectively in a model of a mass-transit organization in one or more areas of activity;

– simulate the execution of the four typical functions of management: planning (setting goals and a course of action), organizing (structuring the job into manageable tasks), directing (assigning tasks and supervising their completion), and controlling (comparing results against the outlined plan).

Applied Work Practices and Procedures

By the end of this course, students will:

– select the most appropriate type of mass-transit system for a particular need;

– effectively model mass-transit systems using a variety of means including software programs or scale models;

– determine cost, quality of service, and capacity considerations in existing forms of public transport;

– develop appropriate models for establishing a fair pricing structure for a mass-transit system;

– simulate the effective management and marketing of a model mass-transit system;

– quantify the financial cost of environmental impacts and carry out an accurate risk analysis;

– analyse the demand for services at different times of the day on a mass-transit system to establish the services required.

Communication Skills

By the end of this course, students will:

– develop an accurate line organization chart of a model mass-transit enterprise in a school transportation facility;

– develop an appropriate flow chart for the major areas of activity in their model mass-transit enterprise;

– generate product specifications for their mass-transit model using engineering drawings, sketches, and reports;

– present effective proposals related to the establishment of a transportation-related enterprise.

Interdisciplinary Skills

By the end of this course, students will:

– apply mathematical skills in spreadsheet analysis to make calculations to close tolerances and to control inventory, costs, and quality;

– use appropriate language in flow charts, operation and inspection charts, job descriptions, lists of tooling requirements, formal presentations, and bills of material;

– apply the technological systems approach to solving a transportation challenge, taking each of the following into consideration: inputs – all the resources needed to accomplish the goals of the system (e.g., people, knowledge, materials, energy, finance, capital); process – the scheme of purposeful actions and practices that make up the technical aspects of the system; outputs – the goal or ends to which the inputs and processes are applied; and feedback – the mechanisms that provide preferred direction for the system.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- explain the social, economic, and environmental consequences and impact of the transportation sector on individuals, society, and the environment;
- effectively evaluate and implement safe work practices when performing transportation-related tasks;
- identify the role of health and safety legislation in transportation technology programs in schools and in the transportation sector;
- describe the postsecondary and career opportunities available in the transportation sector on graduation from a college program.

Specific Expectations

Impacts

By the end of this course, students will:

– identify potential harmful consequences of specific mass-transit activities for the individual and for society, and formulate alternatives to minimize these consequences;

– describe possible negative impacts of transportation activities on the environment and identify a variety of materials, processes, and waste-management methods to minimize them;

– explain the economic impact of the transportation sector on the local community, the province, and the nation.

Safety and Legislation

By the end of this course, students will:

– identify safe work practices and recommend the safest and most appropriate method for a particular operation;

– develop and conduct effective safety audits and inspections of the school transportation facility and implement a plan to address any deficiencies;

– develop an effective emergency action plan for the school transportation facility;

– describe the Occupational Health and Safety Act (OHSA) and identify its implications for the school transportation facility and the transportation sector workplace;

– analyse and describe the issues related to transportation technology addressed in the Workplace Hazardous Materials Information System (WHMIS).

Education, Training, and Career Opportunities

By the end of this course, students will:

– describe career opportunities in the transportation sector following postsecondary training (e.g., management, marketing, finance, production, quality control, engineering);

– identify postsecondary programs associated with the transportation sector and evaluate the appropriateness of the programs to their career plans;

– assess their strengths and limitations in preparation for careers in the transportation sector.

Transportation Technology, Grade 12, Workplace Preparation (TTJ4E)

This course examines the commonalities of land, air, and marine vehicles and transportation systems. Students will develop safe workplace habits and business management skills and will use diagnostic, hand, and power tools effectively to service and repair vehicles to meet industry standards and safety inspections. They will also research the entry requirements for apprenticeship training programs and develop the employability and technical skills required for entry into the workplace.

Prerequisite: Transportation Technology, Grade 11, Workplace Preparation

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- apply the design process to develop solutions, products, processes, or services in response to challenges or problems related to vehicles or vehicle systems;
- analyse and describe a variety of system modifications and their effect on the interrelationship of vehicle systems;
- identify the commonalities of systems in land, air, and marine vehicles;
- describe and evaluate the types of energy and the conversion systems used in different vehicles.

Specific Expectations

The Design Process

By the end of this course, students will:

– explain how human needs or wants related to transportation can be met through a new or improved vehicle or vehicle system;

– apply the following steps of the design process to solve a variety of transportation technology challenges or problems, including problems involving lubrication, cooling, electrical/electronic, fuel intake and exhaust, emission control, suspension and steering, brake, and structural vehicle systems:
  □ identify what has to be accomplished (the problem);
  □ gather and record information, and establish a plan of procedures;
  □ brainstorm a list of as many solutions as possible;
  □ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
  □ evaluate the solutions (e,g., by testing, modelling, and documenting results) and choose the best one;
  □ produce presentation and working drawings, sketches, graphics, mathematical and physical models, or a prototype of the best solution;
  □ evaluate the prototype and determine the resources, including computer applications, required to produce it;
  □ communicate the solution, using one or more of the following: final drawings, graphs, charts, sketches, technical reports, electronic presentations, flow charts, mock-ups, models, prototypes, and so on;
  □ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Vehicle Systems

By the end of this course, students will:

– analyse and describe possible modifications to each of the following systems that are common to vehicles designed for the land, sea, or air: the chassis, frame, and body system; the engine system; the cooling system; the fuel system; the electrical/electronics system; the gear and power train system; the steering system; the brake system; the suspension system;

– explain the effects of modifications to any of a vehicle's components on the vehicle's other systems.

Energy and Energy Conversion

By the end of this course, students will:

– identify differences between the conversion of energy into power in gasoline and diesel engines;
– identify and compare the different torque and power characteristics of gasoline and diesel engines.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- work effectively as members of a team;
- consult appropriate reference materials when servicing and repairing systems;
- use current technology and a variety of troubleshooting techniques to service systems to meet manufacturers' performance specifications;
- communicate ideas and transmit information about materials and specifications effectively when working with others;
- demonstrate a working knowledge of fundamental mathematics and the scientific principles required to service, repair, and modify vehicles.

Specific Expectations

Organizational Skills

By the end of this course, students will:

– demonstrate the following skills: the ability to accept responsibility, delegate tasks when appropriate, communicate effectively, resolve conflicts, manage time effectively, and set goals;

– work effectively with team members to identify the optimum order of operations; determine the availability of tools, parts, and equipment; develop scheduling requirements; and obtain information needed to plan and prepare for the fabrication or repair process.

Applied Work Practices and Procedures

By the end of this course, students will:

– use correctly, store safely, and maintain in good working order the measurement, hand, power, machine, and pneumatic tools and equipment required for service, repair, and modification tasks;

– safely operate a variety of heating, cutting, and welding equipment for service repair and modification tasks;

– systematically troubleshoot problems arising from the service, repair, and modification of vehicles by organizing the variables into the following categories: input, process, and output.

Communication Skills

By the end of this course, students will:

– communicate project ideas effectively using scale drawings and sketches;

– fill in work orders to communicate the materials used and the work practices and procedures related to the job;

– communicate in a clear, concise, and accurate manner when working with colleagues and clients;

– interpret detailed working drawings developed by computer-assisted drafting programs (CAD);

– consult appropriate repair manuals for procedures, schematics, and specifications, and apply them in the repair, service, and modification of vehicle components and systems;

– develop and present effective oral and written reports on service and repair methods, using technical language appropriately.

Interdisciplinary Applications

By the end of this course, students will:

– use mathematics to calculate electrical, mechanical, and fluid power;
– apply scientific principles when determining states of matter and mechanical advantage, and when working with advanced electrical theory within the context of transportation technology.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- evaluate the environmental impacts of using specific products and processes, and recommend alternative methods and materials to reduce any negative impacts;
- develop and conduct effective safety audits and inspections of the school transportation facility and implement a plan to address any deficiencies;
- describe the role of legislation related to the transportation sector and identify its implications for the school transportation facility and for the transportation sector generally;
- identify the career opportunities available through apprenticeships and other training programs related to transportation technology, and assess the aptitudes required for such opportunities;
- demonstrate the employability skills required for success in the workplace.

Specific Expectations

Impacts

By the end of this course, students will:

– evaluate any negative environmental impact of procedures used in the repair and service of vehicles, and suggest environmentally friendly alternatives;

– recommend an effective process for collecting and recycling materials and fluids;

– handle waste products safely and be able to implement an emergency action plan in the event of a minor spill;

– identify the procedures required to eliminate the release of ozone-depleting substances by applying provincial or federal standards during the servicing of mobile air-conditioning units.

Safety and Legislation

By the end of this course, students will:

– demonstrate good housekeeping practices in the work environment by cleaning up spills and leaks, keeping areas clean and clear of obstruction, and storing tools and equipment so that the potential for injuries is minimized;

– use safe work practices in the transportation technology program;

– develop comprehensive safety checklists for applied work practices and procedures;

– use all required protective clothing and gear (e.g., to protect the eyes, hands, head, feet, and respiratory system) when working in the transportation sector;

– identify and adhere to the aspects of the Occupational Health and Safety Act (OHSA), the Workplace Hazardous Materials Information System (WHMIS), and the Motor Vehicle Repair Act that relate to procedures and operations used in the school transportation technology facility.

Education, Training, and Career Opportunities

By the end of this course, students will:

– describe the wide range of career opportunities available in the transportation sector;

– identify the training required to enter apprenticeships for different careers in the transportation sector;

– demonstrate the employability skills identified by the Conference Board of Canada.

Part B. Computer Studies

Computer and Information Science

Overview

Computer and information science is more than running application programs and programming. Rather, it relates to the ways in which computers represent conceptual objects and how computer systems allow those objects to interact. Computer and information science is the study of ways of representing objects and processes. It involves defining problems, analysing and designing solutions, and developing, testing, and maintaining programs.

Computer and information science education is relevant for all students because it incorporates a broad range of transferable problem-solving skills and techniques. It combines logical thinking, creative design, synthesis, and evaluation, and also teaches generically useful skills in such areas as communication, time management, organization, and teamwork.

Computer and information science will prepare students for an increasingly technological world. A foundation in this discipline will introduce students to the excitement and opportunities afforded by this dynamic field and will begin to prepare them for careers in information technology.

Computer and Information Science, Grade 11, University/College Preparation (ICS3M)

This course helps students examine computer science concepts. Students will outline stages in software development, define standard control and data structures, identify on- and off-line resources, explain the functions of basic computer components, and develop programming and problem-solving skills by using operating systems and implementing defined practices. As well as identifying careers in computer science, students will develop an understanding of the ethical use of computers and the impact of emergent technologies on society.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- describe at least two problem-solving models;
- identify the stages in the software development process (problem definition, analysis, design, implementation, testing, and maintenance);
- explain standard control and data structures used in computer programs;
- identify on-line and off-line resources;
- explain the functions of basic computer components.

Specific Expectations

Problem Solving, Logic, and Design

By the end of this course, students will:

– define problems by identifying the expected output and necessary user input;

– evaluate the usefulness of available software tools in a problem-solving situation, using criteria such as ease of use and time required for processing;

– describe the steps in the software development process and their importance in the development of large programs or applications;

– explain different problem-solving models (e.g., top-down, bottom-up) that can be used to create a computer program;

– determine the level of error checking required for given problems;

– identify the possibilities and limitations of proposed designs;

– document for the user the potential and limitations of programs.

Programming Concepts

By the end of this course, students will:

– describe the characteristics of integer, real, character, and Boolean data types;

– define constants, variables, expressions, and assignment statements;

– describe the order in which arithmetic and logical operations are performed;

– explain the use of Boolean operators in compound expressions;

– define the structure of one- and two-dimensional arrays and associated concepts (e.g., subscripts, elements, bounds);

– explain the purpose of selection and repetition structures, and how they are expressed in a programming language;

– describe the purpose of functions and procedures, and how they are expressed in a programming language;

– describe parameter passing and scope;

– identify differences between local and global variables;

– identify differences among logic, runtime, and syntax errors;

– describe the evolution of programming languages (e.g., machine, assembly, high-level, 4GL);

– evaluate available on-line resources such as "readme" files, help files, and "frequently asked questions" files;

– evaluate available off-line resources such as user manuals and reference manuals;

– explain the importance of external and internal documentation and programming style;

– identify common acronyms used in the computing industry.

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– describe the function and location of the basic components of a computer (e.g., motherboard, CPU, I/O devices, memory);

– identify common computer peripheral devices (e.g., mouse, keyboard, screen, printer, multimedia devices) and their primary functions;

– explain differences among software for systems, applications, and programming.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- develop effective programs by following the steps in the software design process;
- use defined programming practices (e.g., headers, indentation, internal documentation, informative variable names);
- produce appropriate internal and external documentation;
- properly use an operating system, including a network.

Specific Expectations

Problem Solving, Logic, and Design

By the end of this course, students will:

– resolve ambiguities and missing information in problem statements;

– use the input, process, and output model to solve problems;

– select suitable data structures to represent information;

– develop and maintain a project plan that covers all aspects of the development process for a computer program;

– develop appropriate algorithms in text or diagram form to solve problems and verify solutions;

– produce user-friendly input and output forms;

– solve the same problem using various tools (e.g., a calculator and a computer program, a sort program and a spreadsheet/database/word processor sort function);

– verify solutions to problems;

– incorporate modularity into the design process.

Programming Practices

By the end of this course, students will:

– use constants, variables, expressions, and assignment statements to store and manipulate numeric, character, and logical data in programs;

– incorporate one-dimensional and two-dimensional arrays into computer programs;

– write programs that use related arrays to store and extract data;

– use selection structures, counted and conditional loops, and nested selection and loop structures;

– manipulate numbers and text using built-in subroutines;

– write subroutines that pass parameters and use local and global variables;

– implement a program design using sequence, selection, and repetition structures;

– use on-line and off-line reference materials effectively;

– adhere to defined programming style, including naming conventions for variables and subroutines, indentation, and spacing;

– incorporate and maintain internal documentation to a specific set of standards, including author, date, file name, purpose, and explanatory comments of major statement groups;
– develop external documentation (including pseudocode, diagrams, and charts) to summarize the design;
– test completed programs with a full range of valid data to ensure that all components work as expected;
– interpret errors during testing and program execution;
– trace program execution using manual methods and software debugging tools;
– identify and correct logic, runtime, and syntax errors in programs;
– use linear searches and simple sort routines in programs;
– write programs that access sequential files;
– perform peer evaluations of internal documentation and programming style.

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– use an operating system to perform tasks such as managing files and configuring hardware;
– use built-in networking functions such as shared files and input/output devices;
– use common Internetworking services to access and navigate global information resources;
– develop computer resources to share information globally or locally;
– implement a comprehensive backup strategy for files.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- explain issues related to the ethical use of computers;
- describe emergent technologies and their impact on society;
- identify information systems and computer science career paths, and their educational requirements.

Specific Expectations

Effects of Information Technology

By the end of this course, students will:

– explain how the pervasiveness of computer technology affects daily life;

– describe how information is gathered using computers and how this can affect peoples' privacy and right to information;

– identify a number of available sources of career and educational information using networks and evaluate their reliability and accuracy;

– describe, using presentation software, emergent technologies and their potential influence on society;

– use appropriate strategies to avoid potential health and safety problems associated with computer use, such as musculo-skeletal disorders and eye strain;

– explain the importance to identifying career paths of keeping up to date on current articles and thought on computer technology.

Postsecondary Education and Career Opportunities

By the end of this course, students will:

– identify postsecondary educational opportunities leading to careers in information systems and computer science, and report on their entry requirements;

– identify which careers require computer expertise, using local or national media;

– identify opportunities for apprenticeship training and co-op programs.

Computer and Information Science, Grade 12, University/College Preparation (ICS4M)

This course helps students use programming and software engineering principles to design and develop algorithms and programs. Students will use software development and diagnostic tools, implement data structures and algorithms, and use file management techniques in project settings. They will also develop an understanding of the ethics of computer use and the impact of information technology on the community, and will explore postsecondary education and career paths in computer science.

Prerequisite: Computer and Information Science, Grade 11, University/College Preparation

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- describe the steps in the software life cycle (problem definition, analysis, design, implementation, testing, and maintenance);
- explain data structures and their processing algorithms;
- analyse a number of programming paradigms;
- explain the importance of program correctness and efficiency;
- describe the relationship among hardware, software, and network requirements.

Specific Expectations

Problem Solving, Logic, and Design

By the end of this course, students will:

– describe the components of the software life cycle and their importance in project settings;

– explain the importance of designing reusable code for large software projects;

– identify similarities and differences among data structures, including arrays, records, and arrays of records, and their applicability to solving programming problems;

– evaluate the efficiency of different algorithms and their applicability to solving the same programming problem;

– describe the difference between procedural and object-oriented programming;

– explain the levels of program correctness: syntax errors, runtime errors, valid data, invalid data, robustness.

Programming Concepts

By the end of this course, students will:

– describe how procedural and object-oriented programming paradigms can be used to solve different problems;

– describe how user-defined types and records provide more flexible and powerful ways of handling data;

– explain how recursion can be used to solve specific kinds of computing problems.

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– explain the role of a network in accessing computer software resources;

– describe the issues involved in maintaining a software library (e.g., access, backup, version control);

– relate hardware requirements to user software demands.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- incorporate the software life cycle in project settings;
- effectively use software development and diagnostic tools;
- implement advanced data structures and algorithms;
- identify on-line and off-line resource materials;
- use file management techniques in project settings.

Specific Expectations

Problem Solving, Logic, and Design

By the end of this course, students will:

– devise a plan for a large software project (e.g., an accounts receivable or a random walker program), outlining the required activities at each stage of the software life cycle;

– use industry-standard methodology (e.g., flow chart, pseudocode, structure chart) in the design process;

– incorporate modularity, software reuse, and maintenance considerations at the design and implementation stages of the project;

– incorporate appropriate code from shared software libraries into software projects;

– select appropriate data structures (e.g., arrays, records, arrays of records) for use in projects;

– design algorithms to incorporate data structures in projects;

– ensure program correctness by developing a complete suite of test data (valid and invalid data) to eliminate syntax, runtime, and logic errors;

– use a problem-solving protocol to trouble-shoot computer programs.

Programming Practices

By the end of this course, students will:

– use an integrated development environment to create and manage a project;

– employ user-defined data types and record data types to improve program efficiency;

– use arrays, records, and arrays of records in different project settings;

– build and maintain a small software library to facilitate the reuse of code;

– incorporate appropriate maintenance considerations during the implementation of programs;

– use recursion in a simple program;

– compare the effectiveness of several algorithms for solving the same problem;

– produce comprehensive documentation (e.g., help files, manuals) for a software project;

– perform peer reviews of internal and external documentation;

– perform line-by-line walk-throughs of computer programs that include all program structures;

– use appropriate research and resource materials to independently master new programming skills;

– effectively critique programs written by others;

– log error messages and appropriate fixes.

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– implement a backup strategy for program files on different media;

– develop software libraries in project settings;

– use predefined modules from software libraries to improve productivity.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe issues related to the ethical use of computers;
- describe the use of information technology and its impact in the community;
- identify postsecondary educational opportunities leading to careers in information systems and computer science;
- explain the importance of employability skills and lifelong learning to information technology careers.

Specific Expectations

The Ethical Use of Computers

By the end of this course, students will:

– explain the importance of the ethical use of computers in areas such as software piracy, privacy, and security;

– describe the essential elements of a code of computing ethics and why it is important to have and follow such a code;

– analyse current media information relating to ethical issues in computing.

Effects of Information Technology

By the end of this course, students will:

– describe how local industries, businesses, or community groups are affected by the growing use of information technology to facilitate communication;

– describe, using presentation software, how local industries, businesses, or community groups use computers to improve efficiency and productivity to serve their clients;

– evaluate the pros and cons of moving to new hardware and software technologies (e.g., costs, training requirements, compatibility, deployment);

– use appropriate strategies to avoid potential health and safety problems associated with computer use, such as musculo-skeletal disorders and eye strain.

Postsecondary Education, Career Opportunities, and Employability Skills

By the end of this course, students will:

– describe the range of career opportunities in computing and their lifelong learning requirements;

– produce job descriptions for occupations/professions in computer and information science;

– demonstrate communication skills (e.g., the ability to provide comprehensive internal documentation and the ability to explain program design and implementation clearly) in a team setting;

– describe the elements of working effectively in a team environment (e.g., conflict resolution, time management, constructive criticism, task assignment).

Computer Engineering

Overview

Computer engineering is an expanding branch of engineering with roots in both electrical engineering and computer science. It includes the design, operation, and maintenance of computer hardware and peripherals (printers, scanners, multimedia devices, and so on). Computer engineers work in every sector of society and industry designing new products and services. Within the field of computer engineering there are also a number of areas of specialization including communications, control systems, and software engineering.

Computer engineering education provides a hands-on understanding of the technology involved in many consumer products and industrial processes. It also teaches generically useful skills, including communication, time management, organization, and teamwork.

Ontario high school students can now interact directly with computer hardware and peripherals and gain a better understanding of the opportunities that this field presents. A foundation in this discipline will provide students with an introduction to the excitement and opportunity offered by computer engineering and will begin to prepare them for careers in computer hardware and networking.

Computer Engineering, Grade 11, University/College Preparation (ICE3M)

This course helps students understand how computer hardware and software are used to solve computer-related problems from an engineering perspective. Students will explore ways of connecting computers, interfaces, and peripherals using their knowledge of logic gates, computer components, peripherals, programming, networks, and operating systems. Students will also construct systems that use computer programs to interact with hardware, install and configure key computer hardware and software components, develop an understanding of the ethical use of computers, and explore careers in computer engineering.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- identify the function and interaction of basic computer components and peripherals;
- describe the relationship among computer hardware, networks, and operating systems;
- explain internal number and character representation systems and how to make conversions among them;
- explain the function of logic gates and combinations of gates;
- describe a problem-solving model and the fundamental programming constructs required to implement it.

Specific Expectations

Computer Logic and Electronics

By the end of this course, students will:

– explain how binary, decimal, and hexadecimal number systems relate to computer logic;

– identify standard ways of representing characters (e.g., ASCII, EBCDIC);

– describe the function of decoder and timer chips and the fundamental logic gates AND, NAND, OR, NOR, XOR, and NOT;

– explain how Boolean algebra relates to the fundamental logic gates;

– describe how combinations of logic gates interact.

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– explain the function and interaction of the basic components (e.g., CPU, I/O devices, memory) of a computer system;

– describe the function and interaction of computer peripherals (e.g., mouse, keyboard, screen, printer);

– identify differences between stand-alone and network hardware;

– describe similarities and differences between network and desktop operating systems.

Programming Concepts

By the end of this course, students will:

– define constants, variables, expressions, and assignment statements, including the order in which the operations are performed;

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

– explain how selection and repetition structures are used in computer programs;

– describe how subroutines are used in computer programs;

– explain parameter passing and scope.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- use internal numbering, character representation systems, and logic gates;
- construct systems that use computer programs to interact with hardware components;
- properly install and configure key computer hardware and software components;
- use network services to facilitate intranetworking among workstations.

Specific Expectations

Computer Logic and Electronics

By the end of this course, students will:

– perform base-to-base conversions;

– perform simple arithmetic with whole numbers in binary;

– build an interface that visually displays internal representations of numbers and characters;

– generate truth tables to represent logic gates and Boolean equations;

– assemble electronic circuits using a series of logic gates.

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– build interfaces that control hardware components (e.g., LEDs, direct current motors, and stepper motors);

– verify the correctness of the input and output of a system consisting of a computer, interface, and a hardware device;

– properly install and configure key software and hardware components and peripherals;

– properly install and configure a workstation operating system, including a network connection;

– demonstrate an ability to download freeware utilities;

– use utilities to compress and expand files;

– properly implement standard network protocols for file transfer.

Programming Practices

By the end of this course, students will:

– use design tools to plan programming solutions (e.g., flow charts, pseudocode, structure charts);

– apply fundamental programming constructs by writing, testing, and debugging programs.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe examples of rapid change in information technology;
- describe the impact of computer technology on society;
- describe issues relating to the ethical use of computers;
- identify computer engineering career paths.

Specific Expectations

By the end of this course, students will:

– describe the evolution and historical impact of developments in computer hardware;

– explain how computer technology affects daily life;

– describe issues that arise from the growing use of networked systems (e.g., complexity, compatibility, security);

– examine a number of available sources of information using a computer network and evaluate their ease of use and reliability;

– describe the computer expertise required for engineering and technology careers;

– identify postsecondary educational opportunities leading to careers in engineering and technology, as well as their entry requirements;

– use a variety of software applications to make class presentations on ethical issues in computing;

– use appropriate strategies to avoid potential health and safety problems associated with computer use, such as musculoskeletal disorders and eye strain.

Computer Engineering, Grade 11, Workplace Preparation (ICE3E)

This course helps students develop a practical understanding of hardware and software operations, computer networks, and operating systems. Students will learn to use utility and application software and to install, maintain, and troubleshoot computer systems and networks following proper maintenance and repair procedures. In addition to developing an understanding of the ethical use of computers, students will identify related career opportunities and the skill sets required for the workplace, including good customer service practices.

Prerequisite: None

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- describe current hardware and software products;
- describe computer networks and operating systems;
- identify required procedures for the safe handling of electronic components;
- define what constitutes good customer service practices.

Specific Expectations

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– identify current hardware products and their uses;

– explain the function of computer peripherals (e.g., mouse, keyboard, screen, printer, multimedia devices);

– explain technical information in current computer advertisements;

– identify current software products, their uses, and their hardware requirements;

– specify criteria for the selection of software;

– explain the hierarchical structure used to organize directories and files;

– describe the advantages and disadvantages of networked versus stand-alone computing;

– describe the concept of a global computer network;

– explain the similarities and differences between local and wide area networks;

– describe the requirements of different operating systems;

– explain the correct procedures for handling components that use electrical power.

Customer Service

By the end of this course, students will:

– describe the importance of telephone etiquette and appropriate personal appearance and demeanor;

– explain the importance of keeping records of customer contacts, including the following: customer name, contact information, date, time, description of technical problem, and proposed solution.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- follow maintenance and repair procedures;
- use utility and application software effectively;
- determine user computing requirements;
- use network services effectively;
- demonstrate professional customer service practices.

Specific Expectations

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– recommend appropriate hardware and software based on user needs;

– cost out computer systems accurately, including all components and peripherals;

– properly set up and configure computer systems;

– follow prescribed troubleshooting procedures effectively;

– properly install and configure expansion components (e.g., video/network/modem cards, memory, secondary storage devices);

– perform basic maintenance on peripherals;

– use utility software to diagnose and correct problems;

– install and update virus-checking software;

– properly install and configure software upgrades;

– use appropriately prescribed methods of handling computer hardware;

– perform backup procedures effectively;

– use network resources to gather product information;

– maintain a glossary of computer terms and acronyms;

– prepare storage media for use;

– design effective home computer set-ups, including technical and ergonomic considerations.

Customer Service

By the end of this course, students will:

– use computer terminology correctly;

– demonstrate an ability to communicate effectively with clients;

– demonstrate an ability to deal with customers in an organized and professional manner;

– maintain service logs effectively using a database and/or word processor;

– develop installation and service procedures;

– demonstrate an ability to follow peer-developed installation or service procedures.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe examples of ethical and non-ethical uses of computers;
- identify skill sets required for the workplace;
- describe workplace opportunities;
- communicate and work effectively individually and in groups.

Specific Expectations

By the end of this course, students will:

– comply with ethical and acceptable policies for computer use;

– identify social and computer skills that are important to employers;

– describe job opportunities in local business and industry;

– employ time management skills effectively in the completion of projects;

– effectively communicate the results of projects both orally and in writing;

– use appropriate strategies to avoid potential health and safety problems associated with computer use, such as musculoskeletal disorders and eye strain.

Computer Engineering, Grade 12, University/College Preparation (ICE4M)

This course helps students understand and apply computer engineering concepts. Students will analyse and design computer components such as logic circuits and interfaces; develop and construct systems and write the associated computer programs to drive real-world devices such as traffic lights, models, and robots; and explore networking hardware, protocols, and configurations. As well as developing project management skills, students will examine the ethics of computer use and explore related educational requirements and careers.

Prerequisite: Computer Engineering, Grade 11, University/College Preparation *or* Computer and Information Science, Grade 11, University/College Preparation

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- describe mechanisms for information movement and storage;
- document network configurations and their services;
- explain the operation of sophisticated systems that interact with real-world devices;
- compare high-level and low-level programming languages.

Specific Expectations

Computer Logic and Electronics

By the end of this course, students will:

– describe how signed and unsigned numbers are represented;

– explain how to determine memory requirements for information storage;

– describe the function and interaction of a control unit, arithmetic logic unit, and memory registers in a simple central processing unit (CPU);

– use a diagram to illustrate how buses move data and instructions between memory and the CPU;

– analyse the role of flip-flops in the flow of data.

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– explain the function and interaction of the basic components of network configurations;

– identify similarities and differences among several network topologies and protocols;

– explain several computer-controlled systems that interact with real-world devices (e.g., traffic management systems, automotive systems, robotic systems).

Programming Concepts

By the end of this course, students will:

– describe the constructs of a simple assembly or machine-level language;

– identify similarities and differences among memory addressing techniques;

– compare high-level and low-level commands that perform similar operations.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- analyse information storage mechanisms;
- use Boolean equations to represent computer logic circuits;
- construct systems and interfaces that use computer programs to interact with real-world devices;
- design effective network configurations;
- develop programs using the software life cycle (problem definition, analysis, design, implementation, testing, and maintenance).

Specific Expectations

Computer Logic and Electronics

By the end of this course, students will:

– convert between decimal and binary numbers;

– build flip-flops using simple logic gates from schematics;

– incorporate flip-flops in a clocked circuit to demonstrate information storage;

– use electronic instruments (e.g., multimeter, logic probe) to troubleshoot circuits;

– simplify Boolean equations accurately;

– draw circuits that represent Boolean equations;

– develop truth tables to represent Boolean equations.

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– analyse existing systems designs that use computers and interfaces to send and receive information;

– design an effective system consisting of a computer and interface that integrates input and output devices (e.g., motion sensitive alarm, light-activated switch, LED sign, environmental control);

– construct a system consisting of a computer and interface to communicate with external sources;

– identify networking problems and troubleshooting procedures;

– describe network hardware and software and their relationships.

Programming Practice

By the end of this course, students will:

– write programs to process input and control output devices through interfaces;

– trace the execution of simple machine-level programs;

– write low-level programs;

– document all programs to a specified standard.

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- identify issues related to the ethical use of computers;
- explain the importance of postsecondary education, employability skills, and lifelong learning to computer engineering careers;
- describe the use of computer technologies and their impact in the community;
- demonstrate project management skills.

Specific Expectations

By the end of this course, students will:

– use appropriate presentation software to explain issues relating to computer ethics (e.g., privacy, security, information access);

– describe industry certification designations and requirements;

– analyse the potential impact of emerging technologies on society;

– use time management skills and constructive criticism in project settings;

– communicate the results of projects effectively both orally and in writing;

– use appropriate strategies to avoid potential health and safety problems associated with computer use, such as musculoskeletal disorders and eye strain.

Computer Engineering, Grade 12, Workplace Preparation (ICE4E)

This course helps students understand network topologies (how computers are connected in networks) and associated hardware, and gain practical knowledge of hardware and software operations and trends. Students will install and maintain computer systems and networks, and diagnose and solve problems in them; develop maintenance and repair protocols; and customize utility and application software to meet user needs. As well as developing skills to communicate with customers, students will examine computer ethics and identify skill requirements for computer support positions.

Prerequisite: Computer Engineering, Grade 11, Workplace Preparation

Theory and Foundation

Overall Expectations

By the end of this course, students will:

- explain current hardware and software trends;
- describe network topologies and associated hardware;
- document computer-related safety practices;
- describe professional customer service practices.

Specific Expectations

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– use relevant technical terminology to describe hardware and software;

– describe current storage devices;

– describe current input and output devices;

– demonstrate an awareness of current trends in hardware development;

– describe the relationship between available software products and user requirements;

– explain the relationship between hardware limitations and software requirements;

– describe common network topologies;

– identify hardware required to set up different types of networks;

– document correct procedures for handling components that use electrical power.

Customer Service

By the end of this course, students will:

– develop effective procedures for tracking client contact;

– describe computer support hierarchies in small, medium, and large organizations;

– explain the importance of maintaining professional standards in communications;

– follow established problem-solving procedures when dealing with clients.

Skills and Processes

Overall Expectations

By the end of this course, students will:

- develop maintenance and repair protocols;
- customize utility and application software appropriately to meet user needs;
- effectively administer and troubleshoot a network configuration and related services;
- recommend solutions to fulfil user computing requirements;
- communicate effectively with customers.

Specific Expectations

Hardware, Interfaces, and Networking Systems

By the end of this course, students will:

– analyse user hardware and software needs;

– write recommendation reports based on user requirements;

– compare hardware and software costs from local, national, or global suppliers;

– use technical information from a variety of sources to solve problems;

– use utility software efficiently to diagnose and correct problems;

– properly install and configure new software and upgrades;

– establish troubleshooting procedures;

– solve problems using data from diagnostic tools;

– properly install and configure expansion components (e.g., video/network/modem cards, random access memory, secondary storage devices);

– properly install devices on networks or stand-alone workstations;

– perform basic maintenance on peripherals;

– design effective backup protocols;

– demonstrate an ability to use manuals and on-line documentation to master new software;

– establish glossaries of common computer terms and acronyms;

– prepare storage media for use;

– effectively critique computer advertisements;

– properly set up and configure a networked workstation;

– design office computer set-ups that include technical and ergonomic considerations.

Customer Service

By the end of this course, students will:

– use computer terminology correctly in dealing with customers;

– communicate effectively with clients and managers;

– provide user-level support for software use;

– establish databases for the maintenance of customer service records;

– apply hardware, software, and networking skills in a real-world setting (e.g., user assistance).

Impact and Consequences

Overall Expectations

By the end of this course, students will:

- describe issues related to the ethical use of computers;
- identify skill sets required for the workplace;
- identify workplace opportunities and the need for lifelong learning;
- communicate and work effectively individually and in groups.

Specific Expectations

By the end of this course, students will:

– describe the components of an acceptable use policy for computers;

– follow proper software licensing and registration procedures;

– explain the importance of maintaining customer confidentiality;

– describe job opportunities in local business and industry;

– explain the need for lifelong learning in the computer industry;

– identify opportunities for further training and certification;

– use time management skills and constructive criticism in project settings;

– communicate effectively both orally and in writing;

– use appropriate strategies to avoid potential health and safety problems associated with computer use, such as musculoskeletal disorders and eye strain

Some Considerations for Program Planning in Technological Education

Teachers who are planning a program in technological education must take into account considerations in a number of important areas. Essential information that pertains to all disciplines is provided in *The Ontario Curriculum, Grades 9 to 12: Program Planning and Assessment, 2000*. The areas of concern to all teachers that are outlined there include the following:

- types of secondary school courses
- education for exceptional students
- the role of technology in the curriculum
- English as a second language (ESL) and English literacy development (ELD)
- career education
- cooperative education and other workplace experiences
- health and safety

Considerations relating to the areas listed above that have particular relevance for program planning in technological education are noted here.

Education for Exceptional Students. The Education Act and regulations made under the act require school boards to provide exceptional students with special education programs and services that are appropriate for their needs.

An Individual Education Plan (IEP) must be developed and maintained for each student who is identified as exceptional by an Identification, Placement, and Review Committee (IPRC). The IEP must outline, as appropriate, any modified or alternative curriculum expectations and any accommodations (i.e., the specialized support and services) that are required to meet the student's needs. The IEP must also identify the methods by which the student's progress will be reviewed. For exceptional students who are fourteen years of age or older and who are not identified solely as gifted, the IEP must contain a plan to help them make the transition to postsecondary education, apprenticeship programs, or the workplace, and to help them live as independently as possible in the community.

An IEP may also be prepared for a student with special needs who is receiving special education programs and/or services but who has not been identified as exceptional by an IPRC.

In planning courses in technological education, teachers must ensure that accommodations are made to meet the needs of exceptional students as set out in their IEPs. For example, teachers should recognize that some students may require focused and specialized directions and advance practice in using equipment, perhaps with the help of a peer. Issues relating to students' ability to use equipment and read accompanying manuals must be addressed before students can be expected to participate effectively.

The Role of Technology in the Curriculum. Technological education encompasses both broad-based technology and computer studies, each of which is unique in its approach to information technology. Students will use applications such as computer-assisted design, engine analysis software, or network management software specific to technological education courses. Using an activity-based, project-driven approach to learning, they will also develop information

technology skills to increase their generic knowledge and support their development of skills such as writing, problem solving, research, and communication. In computer studies courses, students will have an opportunity to create software by designing, writing, and testing computer programs, and they will also learn to assemble, manage, and troubleshoot the complex systems that support these computing activities.

English As a Second Language and English Literacy Development (ESL/ELD). Through a student-centred, project-driven approach, courses in technological education provide all students with an opportunity to develop and demonstrate their knowledge and skills through practical applications. However, given the importance of health and safety issues in this discipline, there are specific challenges for ESL and ELD students. It is critical that teachers ensure that these students fully comprehend rules concerning the safe use of tools and equipment, and understand the health and safety regulations related to working in a shop. ESL and ELD students may also need support in learning the technical terminology that is specific to technological education.

Career Education. In each technological education course, students assess related education and career opportunities and requirements, as well as the pathways from school to work. Where possible, students will visit work sites and interact with volunteer mentors. In addition, by learning to work independently and cooperatively to complete relevant tasks and produce useful products, students will appreciate and understand the expectations of the workplace.

Cooperative Education and Other Workplace Experiences. Technological education programs lend themselves well to planned learning activities outside the classroom. Wherever possible, students should be encouraged to participate in programs such as cooperative education, school-work–transition programs (including the Ontario Youth Apprenticeship Program), and programs related to articulation agreements. In general, technological education programs should be designed to take advantage of local opportunities for students to combine work experience and classroom learning. Programs may also be modified to reflect community needs. In-class and out-of-class components must be carefully matched and monitored so that students' learning experiences are relevant and authentic.

Health and Safety. Health and safety are of paramount importance in technological education programs. As part of every course, students must be made aware that health and safety are everyone's responsibility – at home, at school, and in the workplace. Before using equipment, students must be able to demonstrate knowledge of the equipment being used and the procedures necessary for its safe use. Personal protective gear should be worn as appropriate.

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

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

Teachers must make use of a wide range of available and relevant resources to make students sufficiently aware of the importance of health and safety. These can include materials from the following:

- 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), such as the Construction Safety Association of Ontario (CSAO), the Ontario Service Safety Alliance (OSSA), the Transportation Safety Association of Ontario (TSAO), the Electrical Utilities Safety Association (EUSA), and the Workers' Health and Safety Centre (WHSC), and clinics, such as the Occupational Health Clinics for Ontario Workers.

The Achievement Chart for Technological Education

The achievement chart that follows identifies four categories of knowledge and skills in technological education – Knowledge/Understanding, Thinking/Inquiry, Communication, and Application. These categories encompass all the curriculum expectations in courses in the discipline. For each of the category designations in the left-hand column, the levels of student achievement are described. (Detailed information on the achievement levels and on assessment, evaluation, and reporting policy is provided in *The Ontario Curriculum, Grades 9 to 12: Program Planning and Assessment, 2000*.)

The achievement chart is meant to guide teachers in:

– planning instruction and learning activities that will lead to the achievement of the curriculum expectations in a course;
– planning assessment strategies that will accurately assess students' achievement of the curriculum expectations;
– selecting samples of student work that provide evidence of achievement at particular levels;
– providing descriptive feedback to students on their current achievement and suggesting strategies for improvement;
– determining, towards the end of a course, the student's most consistent level of achievement of the curriculum expectations as reflected in his or her course work;
– devising a method of final evaluation;
– assigning a final grade.

The achievement chart can guide students in:

– assessing their own learning;
– planning strategies for improvement, with the help of their teachers.

The achievement chart provides a standard province-wide method for teachers to use in assessing and evaluating their students' achievement. A variety of materials is being made available to assist teachers in improving their assessment methods and strategies and, hence, their assessment of student achievement.

The ministry is providing the following materials to school boards for distribution to teachers:

– a standard provincial report card, with an accompanying guide
– instructional planning materials
– assessment videos
– training materials
– an electronic curriculum planner

When planning courses and assessment, teachers should review the required curriculum expectations and link them to the categories to which they relate. They should ensure that all the expectations are accounted for in instruction, and that achievement of the expectations is assessed within the appropriate categories. 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. Students should be given numerous and varied opportunities to demonstrate their achievement of the expectations across the four categories. Teachers may find it useful to provide students with examples of work at the different levels of achievement.

The descriptions of achievement at level 3 reflect the provincial standard for student achievement. 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 column of the achievement chart headed "70-79% (Level 3)".

Achievement Chart – Grades 11 and 12, Technological Education

Categories	50–59% (Level 1)	60–69% (Level 2)	70–79% (Level 3)	80–100% (Level 4)
Knowledge/ Understanding	**The student:**			
– knowledge of facts, technical terminology, procedures, and standards	– demonstrates limited knowledge of facts, technical terminology, procedures, and standards	– demonstrates some knowledge of facts, technical terminology, procedures, and standards	– demonstrates considerable knowledge of facts, technical terminology, procedures, and standards	– demonstrates thorough knowledge of facts, technical terminology, procedures, and standards
– understanding of concepts (e.g., uses of computer operating systems)	– demonstrates limited understanding of concepts	– demonstrates some understanding of concepts	– demonstrates considerable understanding of concepts	– demonstrates thorough and insightful understanding of concepts
– understanding of relationships between concepts (e.g., energy conservation and manufacturing processes)	– demonstrates limited understanding of relationships between concepts	– demonstrates some understanding of relationships between concepts	– demonstrates considerable understanding of relationships between concepts	– demonstrates thorough and insightful understanding of relationships between concepts
Thinking/Inquiry	**The student:**			
– thinking skills (e.g., evaluating professional practices and principles)	– uses thinking skills with limited effectiveness	– uses thinking skills with moderate effectiveness	– uses thinking skills with considerable effectiveness	– uses thinking skills with a high degree of effectiveness
– inquiry/design skills (e.g., identifying the problem; formulating questions; planning; selecting strategies and resources; analysing and interpreting information; forming conclusions)	– applies few of the skills involved in an inquiry/design process	– applies some of the skills involved in an inquiry/design process	– applies most of the skills involved in an inquiry/design process	– applies all or almost all of the skills involved in an inquiry/design process
Communication	**The student:**			
– communication of information (e.g., computer and technical specifications)	– communicates information with limited clarity	– communicates information with moderate clarity	– communicates information with considerable clarity	– communicates information with a high degree of clarity, and with confidence
– use of language, symbols, and visuals (e.g., computer programming and technical drawing)	– uses language, symbols, and visuals with limited accuracy and effectiveness	– uses language, symbols, and visuals with some accuracy and effectiveness	– uses language, symbols, and visuals with considerable accuracy and effectiveness	– uses language, symbols, and visuals with a high degree of accuracy and effectiveness

Categories	50–59% (Level 1)	60–69% (Level 2)	70–79% (Level 3)	80–100% (Level 4)
Communication (cont.)	**The student:**			
– communication for different audiences and purposes (e.g., tourism, construction)	– communicates with a limited sense of audience and purpose	– communicates with some sense of audience and purpose	– communicates with a clear sense of audience and purpose	– communicates with a strong sense of audience and purpose
– use of various forms of communication (e.g., presentation software, technical reports)	– demonstrates limited command of the various forms	– demonstrates moderate command of the various forms	– demonstrates considerable command of the various forms	– demonstrates extensive command of the various forms
Application	**The student:**			
– application of ideas and skills in familiar contexts (e.g., demonstrating good customer service practices)	– applies ideas and skills in familiar contexts with limited effectiveness	– applies ideas and skills in familiar contexts with moderate effectiveness	– applies ideas and skills in familiar contexts with considerable effectiveness	– applies ideas and skills in familiar contexts with a high degree of effectiveness
– transfer of concepts, skills, and procedures to new contexts (e.g., applying scientific principles to health care and personal services)	– transfers concepts, skills, and procedures to new contexts with limited effectiveness	– transfers concepts, skills, and procedures to new contexts with moderate effectiveness	– transfers concepts, skills, and procedures to new contexts with considerable effectiveness	– transfers concepts, skills, and procedures to new contexts with a high degree of effectiveness
– application of procedures, equipment, and technology (e.g., use of design instruments, machine and hand tools)	– uses procedures, equipment, and technology safely and correctly only with supervision	– uses procedures, equipment, and technology safely and correctly with some supervision	– uses procedures, equipment, and technology safely and correctly	– demonstrates and promotes the safe and correct use of procedures, equipment, and technology
– making connections, (e.g., between personal experiences and the subject, between subjects, between subjects and the world outside the school)	– makes connections with limited effectiveness	– makes connections with moderate effectiveness	– makes connections with considerable effectiveness	– makes connections 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.

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