11

MECHANICAL MANUFACTURING

INDUSTRIAL DRAFTING

PROGRAM OF STUDY
5725

VOCATIONAL and TECHNICAL EDUCATION

Québec

INDUSTRIAL DRAFTING

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The *Industrial Drafting* program
leads to the Diploma of Vocation Studies (DVS)
and prepares the student to work as an

INDUSTRIAL MACHINERY DRAFTSPERSON

Direction générale de la formation
professionnelle et technique

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INTRODUCTION

The *Industrial Drafting* program is based on a framework for developing vocational education programs that calls for the participation of experts from the workplace and the field of education.

The program of study is developed in terms of competencies, expressed as objectives. These objectives are divided into modules. Various factors were kept in mind in developing the program: training needs, the job situation, purposes, goals, and strategies and means used to attain objectives.

This program of study lists the competencies that are the minimum requirements for obtaining a Diploma of Vocational Studies (DVS) for students in both the youth and adult sectors. It also provides the basis for organizing courses, planning teaching strategies, and designing instructional and evaluation materials.

The duration of the program is 1800 hours, which includes 885 hours spent on the specific competencies required to practise the trade and 915 hours on general competencies. The 25 modules vary in length from 15 to 105 hours (multiples of 15). The time allocated to the program is to be used not only for teaching but also for evaluation and remedial work.

The document contains two parts. Part I is of general interest and provides an overview of the training plan in five chapters. Chapter 1 presents a synoptic table of basic information about the modules; Chapter 2 describes program training goals; Chapter 3 sets out the competencies to be developed; Chapter 4 contains the general objectives; and Chapter 5 provides an explanation of operational objectives. Part II is designed primarily for those directly involved in implementing the program. It contains a description of the operational objectives of each module. It also contains suggestions on the instructional approach and related content for each module in the program. The suggestions are intended for users of the program and are provided for informational purposes only.

In keeping with this broad approach, two accompanying documents will be provided: an evaluation guide and a planning guide.

HARMONIZATION

Industrial Drafting (5725) is a vocational education program in the *Mechanical Manufacturing* sector. It was designed and developed as part of a project to harmonize the different programs in this sector, including *Mechanical Engineering Technology* and *Aircraft Manufacturing Technology* at the college level, as well as *Machining Techniques* and *Numerical Control Machine Tool Operation* at the secondary level.

The different programs were harmonized with a view to achieving continuity between vocational and technical education. The main objective of harmonization is to encourage students to pursue their studies by optimizing their efforts, whether they are returning to school after a period of absence or taking a new career direction. Harmonization makes it possible to move from one program to another or from one level of instruction to another without repeating the same courses.

Tables of equivalents have been designed to show the relationships among the different programs that have undergone harmonization. These tables appear in the following pages.

Equivalences between programs can be of different types. Some competencies are common to several programs of study. Their content is therefore identical, and they bear the same code in all programs in a given level of instruction. Some competencies correspond to several competencies in another program or may be deemed equivalent to a competency in another program by the development team despite the fact that they are not identical. The tables in the following pages illustrate this information. For all other cases, the educational institution is responsible for evaluating and recognizing the prior learning of its students.

The following tables concern all programs involved in the harmonization process. The left-hand column contains the codes and statements of competency of the program in question. The other columns contain the codes of the equivalent competencies in the other programs. Thus, students who have acquired one or more competencies in the program in question will receive recognition for the equivalent competencies in another program if they pursue their studies in that program.

Students who have attained one or more of the competencies of the *Industrial Drafting* (5725) program will receive recognition for corresponding competencies in one of the programs below, if they pursue their studies in that program.

Table 1 – Equivalents for the *Industrial Drafting* program

FROM → TO					
INDUSTRIAL DRAFTING DVS 5725		**Mechanical Engineering Technology (DEC) 241.A0**	**Machining Techniques (DVS) 5723**	**Numerical Control Machine Tool Operation (AVS) 5724**	**Aircraft Manufacturing Technology (DEC) 280.B0**
872 311	Determine their suitability for the trade and the training process				
872 324	Solve problems related to industrial drafting				
872 035	Interpret technical drawings	012F	872 035		
872 335	Produce sketches	012G	872 083		
872 356	Produce detail drawings of mechanical components	012N			011U
872 395	Produce assembly drawings	012U			
872 345	Work at a computerized work station	012M			
872 364	Illustrate fasteners				
872 373	Illustrate the arrangement and movement of the components of a mechanism				
872 386	Interpret technical information about materials and manufacturing processes		872 072		
872 407	Use the specialized functions of a computer-aided drafting program	013C			
872 054	Take and interpret measurements	012P	872 054		
872 414	Determine dimensional tolerances	012S			
872 421	Correct a drawing				
872 436	Illustrate power train systems				
872 446	Produce development drawings	013B			
872 456	Make a three-dimensional model of an object	013D			
872 466	Produce detail drawings of a mechanism				
872 476	Make piping and circuit diagrams				
872 482	Use job search or entrepreneurial techniques		872 271		
872 495	Produce drawings for a mechanical system				
872 507	Draw the housing of a machine				
872 153	Adapt to the new types of work organization	012X	872 153	872 153	0127
872 517	Design a simple technical object				
872 526	Enter the work force				

Students who have attained one or more of the competencies of the *Mechanical Engineering Technology* (241.AO) program will receive recognition for corresponding competencies in one of the programs below, if they pursue their studies in that program.

Table 2 – Equivalents for the *Mechanical Engineering Technology* program

FROM → TO					
MECHANICAL ENGINEERING TECHNOLOGY (DEC) 241.A0		**Industrial Drafting (DVS) 5725**	**Machining Techniques (DVS) 5723**	**Numerical Control Machine Tool Operation (AVS) 5724**	**Aircraft Manufacturing Technology (DEC) 280.B0**
012D	Analyze the occupation				
012E	Solve problems related to industrial mechanics	872 324	872 024		011Q
012F	Interpret technical drawings	872 035	872 035		
012G	Produce sketches	872 335	872 083		
012N	Produce detail drawings of mechanical components	872 356			
012U	Produce assembly drawings	872 395			011U
012H	Interpret technical information about materials and manufacturing processes	872 386	872 072		
012J	Analyze the internal and external forces exerted on a mechanical object				011W
012K	Plan the application of heat treatments				
012L	Do the engineering design of an object's fasteners				
012M	Use a computerized work station	872 345			
012P	Take and interpret measurements	872 054	872 054		
012S	Determine dimensional tolerances	872 414			
012T	Determine the geometric tolerances required for an assembly				011T
012Q	Operate a conventional lathe		872 096		
			872 105		011S
012R	Operate a conventional milling machine		872 118		
012V	Operate a numerical control machine tool		872 206	872 206	
			872 226	872 226	
012W	Program a machining centre manually		872 214	872 214	
0133	Program a numerical control lathe manually		872 194	872 194	
0135	Do automatic programming			872 314	011Z
012X	Adapt to the new types of work organization	872 153	872 153	872 153	0127
012Y	Establish the sequence of operations for manufacturing processes				0129
0134	Develop a process sheet				
012Z	Control the quality of products				
0130	Modify the design concept of the components of a piece of industrial equipment				
0131	Do the engineering design of the tools necessary for a manufacturing project				012A
0132	Watch for new technologies				
0136	Produce the tools necessary to carry out a manufacturing project				
0137	Plan the maintenance of a machine population				
0138	Maintain manufacturing machines				
0139	Organize the work for a medium production run				
013A	Coordinate a medium manufacturing run				

Students who have attained one or more of the competencies of the *Mechanical Engineering Technology* (241.AO) program will receive recognition for corresponding competencies in one of the programs below, if they pursue their studies in that program.

FROM → TO					
MECHANICAL ENGINEERING TECHNOLOGY (DEC) 241.A0		**Industrial Drafting (DVS) 5725**	**Machining Techniques (DVS) 5723**	**Numerical Control Machine Tool Operation (AVS) 5724**	**Aircraft Manufacturing Technology (DEC) 280.B0**
013B	Produce development drawings	872 446			
013C	Use the specialized functions of a computer-aided drawing program	872 407			
013D	Make a three-dimensional model of an object	872 456			
013E	Develop hydraulic and pneumatic circuits for industrial machines				
013F	Do the engineering design of a an industrial piping system				
013G	Do the engineering design of an industrial system				
013H	Do the engineering design of machine housings				
013J	Develop basic automated circuits				
013K	Automate an industrial system				
013L	Coordinate a design project				

Students who have attained one or more of the competencies of the *Machining Techniques* (5723) program will receive recognition for corresponding competencies in one of the programs below, if they pursue their studies in that program.

Table 3 – Equivalents for the *Machining Techniques* program

FROM →		TO			
MACHINING TECHNIQUES (DVS) 5723		**Industrial Drafting (DVS) 5725**	**Mechanical Engineering Technology (DEC) 241.A0**	**Numerical Control Machine Tool Operations (AVS) 5724**	**Aircraft Manufacturing Technology (DEC) 280.B0**
872 011	Determine their suitability for the trade and the training process			872 011	
872 024	Solve mathematical problems related to conventional machining				
872 035	Interpret technical drawings	872 035	012F		
872 041	Avoid occupational health and safety risks				
872 054	Take and interpret measurements	872 054	012P		
872 066	Do shop work				
872 072	Interpret technical information related to materials and manufacturing processes				
872 083	Produce sketches		012G		
872 096	Perform external cylindrical turning operations				
872 105	Perform boring operations		012Q		
872 125	Cut threads on a lathe				
872 118	Perform longitudinal and transverse machining operations on a milling machine				011S
872 133	Perform drilling and reaming operations on a milling machine		012R		
872 178	Perform angular and circular milling operations on a milling machine				
872 144	Grind flat surfaces				
872 153	Adapt to new types of work organization	872 153	012X	872 153	0127
872 162	Become familiar with the workplace				
872 182	Solve mathematical problems related to numerical control machining			872 303	
872 194	Program a numerical control lathe manually		0133	872 194	
872 214	Program a machining centre manually		012W	872 214	
872 206	Machine simple parts on a numerical control lathe			872 206	
872 226	Machine simple parts using a machining centre		012V	872 226	
872 238	Perform complex turning operations				
872 248	Perform complex milling operations				
872 255	Mass-produce parts using conventional machining techniques (optional)				
872 265	Perform machining operations using a boring machine (optional)				
872 271	Explore the possibility of starting their own business				
872 286	Enter the workforce			872 354	

Students who have attained one or more of the competencies of the *Numerical Control Machine Tool Operation* (5724) program will receive recognition for corresponding competencies in one of the programs below, if they pursue their studies in that program.

Table 4 – Equivalents for the *Numerical Control Machine Tool Operation* program

FROM →		TO			
NUMERICAL CONTROL MACHINE TOOL OPERATION (AVS) 5724		**Industrial Drafting (DVS) 5725**	**Mechanical Engineering Technology (DEC) 241.A0**	**Machining Techniques (DVS)[1] 5723**	**Aircraft Manufacturing Technology (DEC) 280.B0**
872 011	Determine their suitability for the trade and the training process			872 011	
872 292	Interpret complex drawings related to numerical control machine tool operations				
872 303	Solve mathematical problems related to numerical control machine tool operation			872 182	
872 194	Program a numerical control lathe manually		0133	872 194	
872 214	Program a machining centre manually		012W	872 214	
872 314	Do automatic programming		0135		011Z
872 206	Machine simple parts on a numerical control lathe			872 206	
872 226	Machine simple parts on a machining centre		012V	3872 26	
872 328	Perform complex machining operations on a numerical control lathe				
872 338	Perform complex machining operations on a machining centre				
872 153	Adapt to the new types of work organization	872 153	012X	872 153	0127
872 346	Mass-produce parts on numerical control machine tools				
872 354	Enter the work force			872 286	

[1] The *Numerical Control Machine Tool Operation* program leads to an Attestation of Vocational Specialization. Students wishing to enrol in this program must have a Diploma of Vocational Studies in *Machining Techniques* or the equivalent scholastic or experiential learning. It is inconceivable that a student study the specialty before enrolling in the basic program. The equivalents in this table are intended merely to indicate the competencies for which a student having obtained a DVS and enrolled in the AVS program would receive recognition.

Students who have attained one or more of the competencies of the *Aircraft Manufacturing Technology* (280.BO) program will receive recognition for corresponding competencies in one of the programs below, if they pursue their studies in that program.

Table 5 – Equivalents for the *Aircraft Manufacturing Technology* program

FROM → TO					
AIRCRAFT MANUFACTURING TECHNOLOGY (DEC) 280.B0		**Industrial Drafting (DVS) 5725**	**Mechanical Engineering Technology (DEC) 241.A0**	**Machining Techniques (DVS) 5724**	**Numerical Control Machine Tool Operation (AVS) 5723**
011P	Analyze the occupation				
011Q	Do calculations related to aeronautics	872 324			
011R	Interpret technical drawings related to aeronautics	872 035	012F	872 035	
011S	Apply the potential of machining processes		012Q 012R		
011T	Ensure the conformity of the dimensional and geometric components of aircraft	872 414	012S 012T		
011U	Produce and modify sketches, technical drawings and models related to aeronautics	872 335 872 356 872 395	012G 012N 012U		
011V	Apply the potential of forming processes				
011W	Optimize the performance of the materials used in aeronautics		012K		
011X	Establish relationships between the operational characteristics of an aircraft and construction principles				
011Y	Design and modify a detail part of an aircraft component				
011Z	Produce and modify programs for numerical control machines		012W 0133 0135		872 194 872 214 872 314
0120	Apply the potential of the forming of composites				
0121	Establish relationships between the characteristics of aircraft systems and design and planning decisions				
0122	Apply the potential of assembly processes				
0123	Design and modify aircraft components				
0124	Find and process technical information				
0125	Develop concepts and procedures related to structural repair				
0126	Contribute to the optimization of the manufacturing process	872 153	012X	872 153	872 153
0127	Interact with colleagues in various work situations				
0128	Ensure quality control		012Z		
0129	Develop and modify process sheets		0134		
012A	Design and modify production tooling for aircraft components		0131		
012B	Develop and modify specifications				
012C	Design and modify the tools required to assemble aircraft components				

GLOSSARY

Program Training Goals
Statements that describe the educational aims of a program. These goals are the general goals of vocational education adapted to a specific trade or occupation.

Competency
A set of knowledge, skills, perceptions and attitudes that enable a person to correctly perform a work-related activity or task.

General Objectives
Instructional objectives that provide an orientation for leading the students to attain one or more related objectives.

Operational Objectives
Statements of the educational aims of a program in practical terms. They serve as the basis for teaching, learning and evaluation. In the competency-based approach, the educational aims are expressed as competencies to be developed.

Module of a Program
A component part of a program of study comprising an operational objective.

Credit
A unit used for expressing quantitatively the value of the modules in a program of study. One credit corresponds to 15 hours of training. Students must accumulate a set number of credits to graduate from a program.

PART I

1. SYNOPTIC TABLE

Number of modules: 25
Duration in hours: 1800
Credits: 120

Industrial Drafting
CODE: 5725

CODE	NO.	TITLE OF THE MODULE	HOURS	CREDITS*
872 311	1	The Trade and the Training Process	15	1
872 324	2	Solving Problems Related to Industrial Drafting	60	4
872 035	3	Interpreting Technical Drawings	75	5
872 335	4	Producing Sketches	75	5
872 345	5	Working at a Computerized Work Station	75	5
872 356	6	Producing Detail Drawings of Mechanical Components	90	6
872 364	7	Illustrating Fasteners	60	4
872 373	8	Illustrating the Arrangement of Components	45	3
872 386	9	Interpreting Technical Information Related tot Materials and Manufacturing Processes	90	6
872 395	10	Produce Assembly Drawings	75	5
872 407	11	Using the Specialized Functions of a Computer-Aided Drafting Program	105	7
872 054	12	Taking and Interpreting Measurements	60	4
872 414	13	Determining Dimensional Tolerances	60	4
872 421	14	Correcting a Drawing	15	1
872 436	15	Illustrating Power Train Systems	90	6
872 446	16	Producing Development Drawings	90	6
872 456	17	Making Three-Dimensional Drawings of an Object	90	6
872 466	18	Producing Detail Drawings of a Mechanism	90	6
872 476	19	Making Piping and Circuit Diagrams	90	6
872 482	20	Using Job Search or Entrepreneurial Techniques	30	2
872 495	21	Producing Drawings for a Mechanical System	75	5
872 507	22	Drawing the Housing of a Machine	105	7
872 153	23	Adapting to the New Types of Work Organization	45	3
872 517	24	Designing a Simple Technical Object	105	7
872 526	25	Entering the Work Force	90	6

** 15 hours = 1 credit

This program leads to a DVS in *Industrial Drafting.*

2. PROGRAM TRAINING GOALS

The training goals of the *Industrial Drafting* program are based on the general goals of vocational education and take into account the specific nature of the trade. These goals are:

1. **To develop effectiveness in the practice of a trade.**
   - To teach students to perform industrial drafting tasks and activities correctly, at an acceptable level of competence.
   - To prepare students to perform satisfactorily on the job by fostering:
     - the intellectual and technical skills needed to think in a structured way and make correct decisions on how to perform tasks;
     - the ability to plan and organize their work and time in accordance with deadlines;
     - the ability to interpret drawings and solve mathematical problems related to machining;
     - attention to detail and precision;
     - the development of a sense of observation and spatial perception;
     - the ability to understand instructions and communicate information effectively and tactfully;
     - the ability to establish interpersonal relations and to work in a team;
     - the acquisition of a technical vocabulary in English and French.

2. **To ensure integration into the job market.**
   - To familiarize students with the job market in general and the trade of industrial draftsperson in particular.
   - To familiarize students with new concepts in work organization.
   - To familiarize students with their rights and responsibilities as workers.

3. **To foster personal and occupational development.**
   - To help students improve their ability to adapt to changes in the world of industrial drafting.
   - To help students develop their autonomy so that they can find information and resource materials and become familiar with new technologies.
   - To help students understand the principles underlying industrial drafting.
   - To help students acquire the basic attitudes required for success, develop their sense of responsibility and instill a desire for excellence.

4. **To ensure job mobility.**
   - To help students develop a positive attitude toward technological change and professional development.
   - To help students develop problem-solving skills.
   - To help students prepare for a creative job search.
   - To help students assess their potential and interest with respect to starting a business.

3. COMPETENCIES

The competencies to be developed in *Industrial Drafting* are shown in the grid of learning focuses on the following page. The grid lists general and specific competencies as well as the major steps in the work process.

General competencies involve activities common to several tasks or situations. They cover, for example, the technological or scientific principles that the students must understand to practise the trade or occupation. Specific competencies focus on tasks and activities that are of direct use in the trade or occupation. The work process includes the most important steps in carrying out the tasks and activities of the trade or occupation.

The grid of learning focuses shows the relationship between the general competencies on the horizontal axis and the specific competencies on the vertical axis. The symbol △ indicates a correlation between a specific competency and a step in the work process. The symbol O indicates a correlation between a general and a specific competency. Shaded symbols indicate that these relationships have been taken into account in the formulation of objectives intended to develop specific competencies related to the trade or occupation.

The logic used in constructing the grid influences the course sequence. Generally speaking, this sequence follows a logical progression in terms of the complexity of the learning involved and the development of the students' autonomy. The vertical axis of the grid shows the competencies directly related to the practice of a specific trade or occupation. These competencies are arranged in a relatively fixed order; therefore, the modules should be taught, insofar as possible, in the order represented on the grid. The modules including the general competencies on the horizontal axis should be taught in relation to those on the vertical axis. This means that some modules are prerequisite to others, while other modules are taught concurrently.

GRID OF LEARNING FOCUSES IN

INDUSTRIAL DRAFTING

SPECIFIC COMPETENCIES
(directly related to the practice of the specific occupation)

				WORK PROCESS (major steps)						**GENERAL COMPETENCIES** (related to technology, subjects, personal development, etc.)														**TOTALS**	
		OPERATIONAL OBJECTIVES	**DURATION (IN HOURS)**	Become familiar with the instructions	Do research	Plan the work	Do the work	Check drawing quality and make corrections	Tidy up	Solve problems related to industrial drafting	Interpret technical drawings	Sketch objects	Work at a computerized work station	Illustrate fasteners	Represent the layout and movement of the components of a mechanism	Interpret technical information about materials and manufacturing processes	Use the specialized functions of a computer-aided drafting program	Determine dimensional tolerances	Correct a drawing	Illustrate power train systems	Make a three-dimensional model of an object	Use job search or entrepreneurial techniques	Adapt to new types of work organization	**NUMBER OF OBJECTIVES**	**NUMBER OF OBJECTIVES**
MODULES	**MODULES**									2	3	4	5	7	8	9	11	13	14	15	17	20	23	14	
	OPERATIONAL OBJECTIVES									B	B	B	B	B	B	B	B	B	B	B	B	S	B		
	DURATION (IN HOURS)									60	75	75	75	60	45	90	105	60	15	90	90	30	45		915
1	Determine their suitability for the trade and the training process	S	15	△	△	△	△	△	△	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		
6	Produce detail drawings of mechanical components	B	90	▲	△	▲	▲	▲	▲	●	●	●	●			❍	❍		❍		❍		❍		
10	Produce assembly drawings	B	75	▲	▲	▲	▲	▲	▲	●	●	●	●	●	❍	●	❍		❍	❍			❍		
12	Take and interpret measurements	B	60	▲		▲	▲	▲	▲	●	●	●		❍	❍	●		❍		❍			❍		
16	Produce development drawings	B	90	▲	△	▲	▲	▲	▲	●	●	●	●	❍		●	❍		❍				❍		
18	Produce detail drawings of a mechanism	B	90	▲	▲	▲	▲	▲	▲	●	●	●	●	●	●	●	●	●	●	●	❍		❍		
19	Make piping and circuit diagrams	B	90	▲	▲	▲	▲	▲	▲	●	●	●	●			❍	●		●				❍		
21	Produce drawings for a mechanical system	B	75	▲	▲	▲	▲	▲	▲	●	●	●	●	●	●	●	●	●	●	●	●		❍		
22	Draw the housing of a machine	B	105	▲	▲	▲	▲	▲	▲	●	●	●	●	●	❍	●	●	●	●	●	●		❍		
24	Design a simple technical object	S	105	▲	▲	▲	▲	▲	▲	●	●	●	●	●	●	●	●	●	●	●	●		●		
25	Enter the workforce	S	90	△	△	△	△	△	△	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍		
	NUMBER OF OBJECTIVES	11																						25	
	DURATION (IN HOURS)		885																						1800

S: Situational objective
B: Behavioural objective

△ Correlation between a step and a specific competency
▲ Correlation to be taught and evaluated
❍ Correlation between a general and a specific competency
● Correlation to be taught and evaluated

4. GENERAL OBJECTIVES

The general objectives of the *Industrial Drafting* program are presented below, along with the major statement of each corresponding operational objective.

To develop in the students the competencies required to determine the information to be included in a drawing.

- Solve problems related to industrial drafting.
- Take and interpret measurements.
- Determine dimensional tolerances.

To develop in the students the essential competencies required to understand mechanical manufacturing.

- Interpret technical information about materials and manufacturing processes.
- Illustrate fasteners.
- Illustrate power train systems.
- Illustrate the arrangement and movement of the components of a mechanism.

To develop in the students the competencies required to perform programming tasks.

- Program a numerical control lathe manually.
- Program a machining centre manually.

To develop in the students the competencies required to produce sketches and drawings.

- Interpret technical drawings.
- Produce sketches.
- Work at a computerized work station.
- Produce detail drawings of mechanical components.
- Use the specialized functions of a computer-aided drafting program.
- Produce assembly drawings.
- Produce development drawings.
- Make a three-dimensional model of an object.
- Produce detail drawings of a mechanism.
- Produce drawings for a mechanical system.
- Make piping and circuit diagrams.
- Correct a drawing.

To develop in the students the competencies required to actively participate in multidisciplinary teams.

- Adapt to new types of work organization.
- Design a simple technical object.

To develop in the students the competencies required to integrate harmoniously into the school and work environments.

- Determine their suitability for the trade and the training process.
- Use job search or entrepreneurial techniques.
- Enter the workforce.

5. OPERATIONAL OBJECTIVES

5.1 DEFINITION

An operational objective is defined for each competency to be developed, as presented in Chapter 3. Competencies are organized into an integrated training program designed to prepare students to practise the trade or occupation. This systematic organization of competencies produces better overall results than training by isolated objectives. More specifically, it fosters a smooth progression from one objective to the next, saves teaching time by eliminating needless repetition, and integrates and reinforces learning material.

Operational objectives are the main, compulsory teaching/learning targets and they are specifically evaluated for certification. There are two kinds of operational objectives: behavioural and situational.

- **A behavioural objective** is a relatively closed objective that describes the actions and results expected of the student by the end of a learning step. Evaluation is based on expected results.
- **A situational objective** is a relatively open-ended objective that outlines the major phases of a learning situation. It allows for output and results to vary from one student to another. Evaluation is based on the student's participation in the activities of the learning context.

5.2 HOW TO READ AN OPERATIONAL OBJECTIVE

A. How to Read a Behavioural Objective

Behavioural objectives consist of five components. The first two provide an overview of the objective:

- The **expected behaviour** states a competency in terms of the general behaviour that the students are expected to have acquired by the end of the module.
- The **conditions for performance evaluation** define what is necessary or permissible to the students during evaluation designed to verify whether or not they have attained the objective. This means that the conditions for evaluation are the same wherever and whenever the program is taught.

The last three components ensure that the objective is understood clearly and unequivocally:

- The **specifications of the expected behaviour** describe the essential elements of the competency in terms of specific behaviours.
- The **specific performance criteria** define the requirements for each of the specifications of behaviour. They ensure a more enlightened decision on the attainment of the objective.
- The **field of application** defines the limits of the objective, *where necessary*. It indicates cases where the objective applies to more than one task, occupation or field.

B. How to Read a Situational Objective

Situational objectives consist of six components:

- The **expected outcome** states a competency as an aim to be pursued throughout the course.

- The **specifications** outline the essential aspects of the competency and ensure a better understanding of the expected outcome.

- The **learning context** provides an outline of the learning situation designed to help the students develop the required competencies. It is normally divided into three phases of learning:
  - information
  - performance, practice or involvement
  - synthesis, integration and self-evaluation

- The **instructional guidelines** provide suggested ways and means of teaching the course to ensure that learning takes place. These guidelines may include general principles or specific procedures.

- The **participation criteria** describe the requirements the students must fulfil. They focus on how the students take part in the activities rather than on the results obtained. Participation criteria are normally provided for each phase of the learning context.

- The **field of application** defines the limits of the objective, *where necessary*. It indicates cases where the objective applies to more than one task, occupation or field.

Note: In this program, the objectives are also accompanied by suggestions concerning the instructional approach and related content applicable to the specifications of the expected behaviour, in the case of a behavioural objective, or to the phases of the learning context, in the case of a situational objective. Since this information was used to determine the competencies, it might be useful for those involved in the implementation of the program. It goes without saying that the suggestions and related content are provided for informational purposes only.

PART II

MODULE 1: THE TRADE AND THE TRAINING PROCESS		CODE: 872 311 15 HOURS
Expected Outcome	**Instructional Guidelines**	**Suggested Approach**
Determine their suitability for the trade and the training process. *Specifications*: Be familiar with the nature of the trade. Understand the training plan. Confirm their career choice. Be aware of the impact of new management approaches in Québec businesses.	• Create a climate that helps the students to enter the job market. • Encourage the students to engage in discussions and express themselves. • Help the students acquire an accurate perception of the trade, especially with respect to the new types of work organization. • Provide the students with the means to assess their career choice honestly and objectively. • Organize field trips to companies that are representative of the work environment, visits to exhibitions, meetings with trade specialists, conferences, etc. • Make available to the students a selection of relevant literature. • Provide the students with an outline for their report and help them produce their documents.	• An observation checklist would make it easier to follow the students' progress in developing this competency.

Learning Context	Participation Criteria	Suggested Related Content
PHASE 1: **Information on the Trade**	- Gather information on most of the topics to be dealt with. - Express their views on the trade at a group meeting, relating them to the information they have gathered.	
• Learning about the types of companies that employ industrial draftspersons and about the different types of work organization.		• Size of the company, sector of economic activity, type of clientele, type of production, manufacturing processes and use of new types of equipment • Types of management and work organization, in accordance with current standards • Other
• Describing factory production and the different jobs involved.		• Stages in the production process: - research into new processes - design and drawing of products - design of transformation methods or processes - optimization of production - training of personnel - planning - performance of transformation or manufacturing processes - inspection (planning and testing) - planning and performance of equipment maintenance - application of management techniques • Distribution of practicums among jobs involved

Learning Context	Participation Criteria	Suggested Related Content
• Learning about the nature and requirements of the job.		• Reference to Chapter 1 of the job situation analysis report: work environment, job prospects, salaries, opportunities for transfer and advancement, selection of candidates, etc. • Position of industrial drafting in the company's organizational chart • Specific requirements of the job • Determination of duties and responsibilities of workers • Their role in various work teams • Participation in the optimization of production • Other
• Examining trade-related tasks and operations.		• Reference to Chapter 2 of the job situation analysis report
• Examining the skills and behaviours needed to practise the trade.		• Reference to Chapter 3 of the job situation analysis report

Learning Context	Participation Criteria	Suggested Related Content
• Presenting the information gathered and discussing their views on the trade (i.e. advantages, disadvantages, requirements) at a group meeting.		• Rules governing group discussion • Attitudes and behaviours: respect, politeness, attentiveness • Knowledge, skills and aptitudes required to practise the trade • Definition of their preferences and interest with respect to machining techniques
PHASE 2: **Information on Training and Participation in the Training Process**	- Study carefully the written material provided. - Express their views on the program of study at a group meeting.	
• Learning about the program of study and the training process.		• Examination of the program of study, especially the synoptic table, the program training goals and general objectives, and the objectives and standards • Information on evaluation, certification of studies and course structure
• Discussing the relevance of the program given the work situation.		• Comparisons between the job situation analysis report and the competencies included in the program
• Sharing their initial reactions to the specialized trade and the training program.		• Verification of opportunities afforded by technological development, new types of work organization, new materials, etc.
• Learning about the concept of techno-watch and further training.		• Upgrading to keep pace with technological development • Adaptation to new management approaches • Career progress • Change of career direction • Development of trade-related knowledge, personal culture, etc. • Examination of opportunities afforded by further training

Learning Context	Participation Criteria	Suggested Related Content
PHASE 3: **Evaluation and Confirmation of Their Career Choice** • Producing a report in which they: - state their preferences, aptitudes and interest with respect to the trade - assess their career choice by comparing the different aspects and requirements of the trade with their own preferences, aptitudes and interests	- Write a report that: - sums up their preferences, aptitudes and interests - explains clearly how they arrived at their career choice	• Parts of a report • Items to include • Production of the report using the outline provided by the instructor • Neatness, clarity and concision

MODULE 2: SOLVING PROBLEMS RELATED TO INDUSTRIAL DRAFTING CODE: 872 324 60 HOURS		
Expected Behaviour	**Conditions for Performance Evaluation**	**Suggested Approach**
Solve problems related to industrial drafting.	• Given data and drawings related to mechanical components • Using a calculator	• Without restricting discussion to theoretical principles, introduce practical problems connected with later modules • Problems in algebra, geometry and trigonometry should be solved using data and drawings connected with mechanical components • Encourage students to apply mental arithmetic

Specifications	Performance Criteria	Suggested Related Content
1. Determine the linear, curvilinear and surface dimensions of an object, with and without tolerances.	1.1 Accurate conversion between metric and imperial systems of measurement using a calculator 1.2 Efficient use of the functions of a scientific calculator: - basic operations - trigonometric functions - exponents - memory 1.3 Accurate conversion of distance and surface measurements 1.4 Accurate calculations 1.5 Proper application of formulae 1.6 Comparison of results with determined reference measurements 1.7 Logical approach to problem solving	• Difference between standard and scientific calculators • Familiarity with keys and functions • Two-way conversion of data • Solving of problems in metric and imperial systems of measurement • Formulae and operations to determine length, segments of straight lines, arcs, chords, angles, perimeters and circumferences
2. Determine the mass of a component.	2.1 Accurate calculation of surface area 2.2 Accurate calculation of volume 2.3 Accurate determination of mass 2.4 Correct conversion of metric and imperial systems of measurement 2.5 Proper application of formulae 2.6 Efficient use of material density tables 2.7 Comparison of results with determined reference mass 2.8 Logical approach to problem solving	• Solving of problems in metric and imperial systems of measurement • Formulae and operations to determine the surface area of circles, triangles, quadrilaterals and polygons • The volume of prisms, pyramids, cylinders and cones • Mass • Calculations for the manufacture of gear systems • Preliminary calculation of chain length for catalogue selection (procedure)

Specifications	Performance Criteria	Suggested Related Content
3. Calculate the dimensions of a triangular component.	3.1 Accurate calculation of distances, angles, surfaces and volumes for right-angled and scalene triangles 3.2 Application of Pythagoras' theorem and trigonometric functions to solve problems 3.3 Proper use of trigonometric formulae	• Solving of problems in metric and imperial systems of measurement • Solving problems using Pythagoras' theorem: - right-angled triangles - scalene triangles (all kinds) • Solving problems involving - distances - angles - surface area - volume
4. Calculate gear ratios and power ratios in a gear system.	4.1 Accurate calculation of dimensions in metric and imperial systems of measurement 4.2 Proper application of algebraic formulae 4.3 Determination of the geometric characteristics of an object, to be used in solving problems	• Solving equations given data and drawings connected with mechanical components and using the rule of three • Use of conventional signs to solve algebraic problems: - formula transposition - meaning of exponents • Resolution of equations with one unknown

MODULE 3: INTERPRETING TECHNICAL DRAWINGS **CODE: 872 035 75 HOURS**

HARMONIZATION:
This module is equivalent to Module 3 of *Machining Techniques* (DVS) and competency 012F of *Mechanical Engineering Technology* (DEC).

Expected Behaviour	Conditions for Performance Evaluation	Suggested Approach
Interpret technical drawings.	• Given: - detail and assembly drawings in metric and imperial units of measurement - drawings illustrating an assembly method or other illustrations - instructions - technical documentation - tables - drafting standards	• Select drawings that will be used for the specific competencies. • Help the students develop spatial perception by having them read examples of descriptive geometry. • Keep assembly drawings for the end of the module. • Research related to the manufacture of parts should be integrated into the relevant specific competencies. • Accustom the students to consulting drawings that use English and French terminology.

Specifications	Performance Criteria	Suggested Related Content
1. Visualize a complete part.	1.1 Accurate differentiation among the types of projections: - American and European orthographic projections - axonometric projections 1.2 Proper identification of views and sections 1.3 Accurate interpretation of lines and hatching lines 1.4 Accurate identification of part on assembly drawing 1.5 Accurate observations of the shape of the part and its position in the whole 1.6 Proper drawing of symmetry of illustrated part 1.7 Relevant association of lines, points and surfaces in different views	• Arrangement of views • Perspectives • Projection plane • Contour lines • Visible and hidden lines • Centre lines • Top view • Front view • Side view (right and left) • Full, partial, half and broken-out sections • Auxiliary views: depth dimensions, front view, top view • Revolved and removed sections • Standard hatching lines for the materials used • Sectional plan • Break line • Standards and conventions • Cut-away view of threads • Principles underlying projection • Reference plane

Specifications	Performance Criteria	Suggested Related Content
2. Interpret the dimensioning.	2.1 Thorough identification of information needed for the job: - dimensions - dimensions with tolerances - form and positioning tolerances, and backlash - nomenclature of threads - fit tolerances 2.2 Determination of value of: - dimensions - dimensions with tolerances - form tolerances - positioning tolerances - backlash - size and location dimensions 2.3 Relevant associations between the dimensions and the surfaces of various views	• Extension line • Dimension line • Standardized dimensioning • Dimensions with tolerances: reference dimension, basic dimension, minimum dimension, maximum dimension and maximum and minimum limit • Form tolerances: straightness, flatness, circularity and cylindricity • Positioning tolerances: location, parallelism, squareness, coaxiality, symmetry and angularity • Single and double backlash • Standardized adjustments: - clearance fit - transition fit - interference fit • Symbols • Modifying symbols • Reference surfaces
3. Find complementary information in technical drawings.	3.1 Proper identification of information in: - title block - list of terms used - annotations 3.2 Thorough identification of information needed 3.3 Accurate interpretation of symbols, codes and abbreviations	• Scale, codification of materials, symbols, abbreviations, etc. • Tolerances, surface conditions, roughness index symbols, etc. • Standards and conventions

Specifications	Performance Criteria	Suggested Related Content
4. Determine the function of the components of an assembly.	4.1 Thorough identification of the components of an assembly in an assembly drawing 4.2 Recognition of the characteristics of the components 4.3 Recognition of the function of each component of the assembly and its relationship with the other components	• Functions: permanent or temporary installation, fastening, transformation of motion, power transmission, leak tightness, stops, etc. • English and French terminology • Diagrammatic view • Parts • Fasteners • Machine parts • Seals • Bushings and bearings • Principles underlying assembly • Principles underlying power transmission • Principles underlying the transformation of motion • Standardized phantom lines

MODULE 4: PRODUCING SKETCHES **CODE: 872 335 75 HOURS**

HARMONIZATION:
This module is equivalent to module 8 of *Machining Techniques* (DVS) and competency 012G of *Mechanical Engineering Technology* (DEC).
The content of modules 4, 6 and 10 of this program corresponds to competency 011U of *Aircraft Manufacturing Technology* (DEC).

Expected Behaviour	Conditions for Performance Evaluation	Suggested Approach
Produce sketches.	• Given: - detail and assembly drawings in metric and imperial units of measurement - American and European orthographic projections - axonometric projections - real parts to be sketched • Drawing freehand or using basic instruments • Using - plotting and isometric paper - measuring instruments - different reference materials, such as tables, nomographs and technical manuals - a scientific calculator • Conformity with standards	• Point out the importance of sketching in the industry. • Have the students sketch using both the metric and imperial systems of measurement. • Help the students develop freehand drawing skills or the ability to draw using only basic instruments such as a ruler, dividers, a square and plotting paper. • Help the students develop spatial perception using different methods. • Demand serious, careful work. • Provide students with individualized support. • To help integrate basic concepts related to sketching and drawing, this competency can be presented concurrently with the competency *Interpret technical drawings.* Also, conventional drawing may be used as a supplementary learning activity.

Specifications	Performance Criteria	Suggested Related Content
1. Sketch orthographic projections.	1.1 Conformity with standards and conventions related to: - lines - American projections - European projections 1.2 Accurate identification of dimensions of part to be sketched 1.3 Determination of the number and types of views 1.4 Observance of proportions and shapes of the object to be sketched 1.5 Proper application of sketching techniques 1.6 Accurate, clean lines	• Types of lines: fine, medium and heavy • Types of conventional lines: - construction - visible features - hidden features - centre - cutting - broken - dimension - extension • Techniques for drawing lines: - horizontal - vertical - skew - curved • Use of basic instruments: pencil, rulers (metric and imperial systems of measurement), plotting paper, etc. • Principle of orthographic projection according to the American and European methods • Number and names of views • Arrangement of views • Relationships among the different views • Choice of number and types of views in accordance with: - shape of part - complexity of part - other • Surface intersections and tangents • Scale • Representation of: - holes - fillets and rounds - edges and phantom lines - symmetrical parts - threaded parts • Method of measuring a part to be sketched • Method of examining an assembly drawing in order to sketch an orthographic projection

Specifications	Performance Criteria	Suggested Related Content
2. Sketch axonometric projections.	2.1 Conformity with standards and conventions related to: - lines - isometric drawings - oblique projections 2.2 Accurate identification of dimensions of the part to be sketched 2.3 Observance of proportions 2.4 Observance of shapes of the object to be sketched using skewed lines and ellipses 2.5 Observance of sketching techniques 2.6 Accurate, neat sketch	• Method of identifying the dimensions of a part to be sketched • Types of axonometric projections: - isometric - oblique: cabinet and cavalier • Methods of drawing an axonometric projection • Use of isometric paper • Method of examining an assembly drawing in order to sketch an axonometric projection
3. Sketch sectional, auxiliary and partial views.	3.1 Conformity with standards and conventions related to: - lines - hatching lines - sections 3.2 Appropriate choice of section 3.3 Observance of proportions and shapes of the object to be sketched 3.4 Observance of sketching techniques 3.5 Accurate, neat sketch	• Representation of hidden shapes and parts • Importance of an appropriate section • Methods of producing sections • Types of sections: - full - broken-out with parallel planes - broken-out with intersecting planes - half - partial - removed - revolved • Section of a rib • Broken-out views • Types of hatching lines, in accordance with the materials • Sections in isometric and oblique perspective • Purpose and method of sketching an auxiliary view • Auxiliary sections • Purpose and method of sketching a partial view

Specifications	Performance Criteria	Suggested Related Content
4. Dimension the sketch.	4.1 Conformity with standards and conventions related to: - extension lines - dimension lines - conventional and absolute dimensioning - notation of dimensions in axonometric projections 4.2 Proper arrangement of dimensions 4.3 Dimensioning adapted to manufacturing 4.4 Appropriate tolerance limits and surface finishes according to the role of the part or one of its components 4.5 Proper use of symbols 4.6 Proper use of metric and imperial systems of measurement 4.7 Neat, clear dimensioning	• Techniques for noting dimensions: - extension lines - dimension lines - reference lines - arrowheads - position of dimensions - orientation of dimensions - other • Basic principles of dimensioning • Conventional and absolute dimensioning • Standardized symbols for dimensioning • Dimensions with tolerances: - basic dimension - average dimension - minimum dimension - maximum dimension - upper and lower limits • Size and location dimensions • Dimensioning of holes • Dimensioning of different views in orthographic projection • Dimensioning of drawings in isometric perspective • Symbols for the roughness index and shaping methods • Standardized classes of fit • Method of examining an assembly drawing in order to produce a dimensioned sketch • Metric and imperial systems of measurement

Specifications	Performance Criteria	Suggested Related Content
5. Write the annotations and information in the title block.	5.1 Complete information 5.2 Clarity and concision of notes 5.3 Annotations adapted to manufacturing 5.4 Proper use of the metric and imperial systems of measurement 5.5 Neatness of annotations and information in the title block	• Leaders • Method of writing annotations in accordance with the operations to be performed • General and specific notes • Information in the title block • Metric and imperial systems of measurement

MODULE 5: WORKING AT A COMPUTERIZED WORK STATION		**CODE: 872 345 75 HOURS**
HARMONIZATION: **This module is equivalent to competency 012M of *Mechanical Engineering Technology* (DEC).**		
Expected Behaviour	**Conditions for Performance Evaluation**	**Suggested Approach**
Work at a computerized work station.	• Given a computerized work station, connected to a network and to the Internet • Using wordprocessing and spreadsheet software • Using software in French and English • Using relevant technical documentation	• Base the work on demonstrations, exercises and examples of real-life situations • Require students to work regularly and impose compulsory class attendance to ensure that no students fall behind • Introduce information on the operating system only toward the last quarter of the module, when the students will be able to distinguish easily between program commands and system commands • Make sure the students are aware of the importance of: - respecting copyright - applying ergonomic rules • Ensure that the students acquire the relevant technical vocabulary in French and in English

Specifications	Performance Criteria	Suggested Related Content
1. Prepare the work station.	1.1 Accurate identification of the components of a computerized work station 1.2 Accurate location and identification of computer components and peripheral devices 1.3 Methodical checking of connections 1.4 Functional and ergonomic organization of the work station 1.5 Appropriate formatting of diskettes	• Identification of computer components, types of software and types of memory • Identification of peripheral devices and their role: mouse, keyboard, screen, modem, printer and plotter • Definition of terms describing desktop computers and their operation • Understanding of how computer viruses are transmitted • Differentiation of standalone work stations and network work stations • Explanation of the advantages and disadvantages of a personalized computer environment • Explanation of memory management menus and programs • Launching of software and accessing of menus • Display of information on disk and diskette content

Specifications	Performance Criteria	Suggested Related Content
2. Use the basic functions of an operating system.	2.1 Appropriate use of the main functions of a graphical environment such as windows, dialogue boxes, menus, tools and scrolling 2.2 Observation of proper procedure for creating, saving and printing documents 2.3 Observation of proper procedure for switching between and moving data from one program to another 2.4 Proper use of the main functions of file management programs for various types of hardware: hard disks, diskettes and CD-ROMs 2.5 Observation of proper procedure for compressing and decompressing files 2.6 Appropriate personalization of the graphical environment of the operating system as required 2.7 Observation of proper procedure for closing down the computer after a work session	• Differences between various printer configurations • Explanation of the role of print management programs • Print-screen and print-file commands • Making of back-up diskettes (including labelling) • Opening of programs • Selection of options from the menu bar using keyboard or mouse • Changing of single and multiple window sizes • Closing of single and multiple windows • Use and movement of dialogue boxes • Use of scroll bars • Use of file management programs: - assignment of file names - creating, copying and deleting of files and folders • Formatting of diskettes using keyboard and mouse • Copying of diskettes on a computer with two identical or two different drives • Personalization of the graphical environment
3. Solve problems within program using Help function.	3.1 Effective searching 3.2 Appropriate interpretation and application of solutions 3.3 Accurate translation of technical terms used in English-language software	• Use of Help function and on-screen assistant • Use of operating system manual and peripheral equipment manuals

Specifications	Performance Criteria	Suggested Related Content
4. Produce a short document using word processing software.	4.1 Appropriate selection of standard and page layout tools, according to function 4.2 Use of appropriate commands to: - modify text - format text - number pages - create a table - use the dictionary - insert page breaks and section breaks	• Use of tool bars, rulers and buttons • Changing of fonts and font size • Opening of existing documents • Creating, saving and locating of files • Setting of margins and alignments • Text layout: - lines (including hyphenation and alignment); - columns using tab stops - for a single page - for an entire document • Creation of tables • Creation of summaries and descriptions for file management • Selection, copying and moving of text • Search and replacement • Use of spelling and grammar checks • Print preview and printing • Insertion of dates within documents

Specifications	Performance Criteria	Suggested Related Content
5. Produce a document using spreadsheet software.	5.1 Appropriate selection of standard and page layout tools, according to function 5.2 Use of appropriate commands to: - create a spreadsheet - copy and move cells - enter and copy data - modify data - modify rows and columns - perform calculations 5.3 Appropriate use of anti-virus software commands	• Spreadsheets: columns, cells, addresses, fields, headings, values • Use of menus and menu bars • Use of spreadsheet: cell (value, heading), address, field • Closing of spreadsheet program without saving • Selection of cells using mouse and keyboard commands • Use of headings: - left and right alignment of headings - centring of headings - long headings • Entering of numbers and formulae • Copying of data and forms using menus, buttons and mouse • Changes to cell alignment and cell content • Total replacement of cell content • Deletion of content of one or more cells • Inserting and deletion of more one more rows or columns • Modification and adaptation of column width to fit longest entry • Print preview and printing • Saving and storing spreadsheets

Specifications	Performance Criteria	Suggested Related Content
6. Use the Internet.	6.1 Selection of appropriate functions of browser software 6.2 Efficient browsing to find information 6.3 Observation of proper procedure for creating a “favourites” file 6.4 Observation of proper procedure for processing electronic mail 6.5 Observation of proper procedure for downloading and printing text, drawings and pictures	• Opening of browser software • Use of tool bars • Use of common search engines • Use of "previous", "next," "home," "load," "refresh," "images," "open," "go to," "open," "print," "search" and "stop" buttons • Entry and modification of active page address • Opening, saving and closing of a window or Web page • Printing of a Web page • Commands: select, cut, cut, paste, copy to clipboard • Commands for “favourites” • Reception and sending of electronic mail • Identification of file extensions for electronic mail • Image format and image downloading

MODULE 6: PRODUCING DETAIL DRAWINGS OF MECHANICAL COMPONENTS		**CODE: 872 356 90 HOURS**
HARMONIZATION: **This module is equivalent to competency 012N of *Mechanical Engineering Technology* (DEC). The content of modules 4, 6 and 10 of this program corresponds to competency 011U of the *Aircraft Manufacturing Construction Technology* (DEC).**		
Expected Behaviour	**Conditions for Performance Evaluation**	**Suggested Approach**
Produce detail drawings of mechanical components.	• For simple components without fasteners and power train components • For orthographic projections requiring exterior, sectional and auxiliary views • Given annotated preliminary drawings in French and English • Using a computerized work station including a plotter • Using computer-aided drafting software • Using technical documentation in English and French	• Use AutoCAD software or the most common software in current use, depending on technological developments. Sample other software where time permits. No "design" software should be used at the secondary level. • All the basic notions will have been mastered previously in the modules on interpreting technical drawings and producing basic sketches; it is strongly recommended that the sketches produced for those modules be used in this module. • The evaluation should focus on two items: optimum use of software commands and the production of a detail drawing. • There should be one work station per student. • Students should be provided with all relevant reference documents, including AutoCAD user's manuals. • To facilitate comprehension, comparisons should be made with conventional drawing. Students should be shown that the stages in the process are basically the same, but that the medium is different. • Students should be taught how to use the various commands gradually, but the main commands should be demonstrated at the beginning to allow the students to produce real drawings of limited complexity.

Expected Behaviour	Conditions for Performance Evaluation	Suggested Approach
		• It is important to pay particular attention to the choice of exercises. The drawings requested must be adapted to the commands taught during a given stage. The last drawings produced should, as far as possible, involve the use of all the commands taught during the module. • Examples should stick as closely as possible to actual industrial practice: standards and conventions, industrial parts, etc. • The work should focus on precision towards the end of the module. • It is important to ensure that students acquire the relevant technical vocabulary in French and in English • Content should be adapted to reflect changes in the software used.

Specifications	Performance Criteria	Suggested Related Content
1. Organize the work.	1.1 Accurate interpretation of lines, notes and dimensions in the preliminary drawing 1.2 Appropriate selection of views, sections and auxiliary views 1.3 Ergonomic preparation of the computerized work station 1.4 Appropriate definition of parameters for the electronic document complying with the system of measurement indicated 1.5 Appropriate layout sketch showing the component and relevant views	• Interpretation of drawings in isometric or oblique perspective • Compliance with ergonomic rules: - screen angle and distance from screen - correct posture • Opening of software • Selection of system of measurement (imperial or metric) • Preparation of electronic document: - units of linear measurement - units of angular measurement - direction of rotation • Preparation of the computer environment: - setting of absolute, relative or polar coordinates - setting of pointer and grid values - examination of menu hierarchies - preparation of prototype drawings - preparation of layers, and assignment of colours and lines

Specifications	Performance Criteria	Suggested Related Content
2. Draw exterior views of component.	2.1 Appropriate and optimum use of basic software commands, including commands to create and insert blocks 2.2 Appropriate arrangement of exterior views 2.3 Concordance of different exterior views 2.4 Correspondence between exterior views and perspective drawing 2.5 Arrangement of details in conformity with dimensions on preliminary drawing 2.6 Observation of drawing conventions	• Use of and alterations to elements using basic commands: - *line* - *circle* - *arc* - *offset* - *polygon* - *donut* - *text*, *dtext* • Use of commands to alter elements: - *copy* - *array* - *break* - *chamfer* - *fillet* - *erase* - *mirror* - *move* - *undo* and *redo*

Specifications	Performance Criteria	Suggested Related Content
3. Draw sectional views.	3.1 Appropriate arrangement of sectional views 3.2 Concordance between the different sectional views 3.3 Correspondence between sectional and exterior views 3.4 Use of standard symbols to indicate materials 3.5 Arrangement of details in compliance with the dimensions on the preliminary drawing 3.6 Observation of drawing conventions and standards 3.7 Appropriate use of basic CAD software commands	• Selection of exterior views: front, top, left, right, bottom, rear • Presentation of views (regular and special) • Arrangement of views • Use of standard lines • Presentation of break line • Selection of type of sectional view: full, partial, half, broken-out, special (ribs, spokes, etc.) • Recognition and reproduction of standard hatching lines • Concordance of points, lines and surfaces of sectional view with: - another sectional view - an exterior view • Use of information commands: - determination of a point "*id*" - measurement of distance "*dist*" - list of information on elements (*list, dblist*) - information on a command or variable - drawing characteristics "*status*" • Use of commands to control on-screen display of elements: - expand and reduce elements to determined scale and surface "*zoom,*" *"rtzoom"* - displace page on screen "*pan,*" *"rtpan"* - redraw elements of drawing "*redraw*" - regenerate elements of drawing "*regen*" - *"fillmode"* variable - display pointer trails "*dragmode*" • Hatching command "*hatch*" and symbols

Specifications	Performance Criteria	Suggested Related Content
4. Draw auxiliary views.	4.1 Correct selection of auxiliary views 4.2 Appropriate arrangement of auxiliary views 4.3 Concordance between different auxiliary views 4.4 Correspondence between auxiliary views and exterior views 4.5 Arrangement of details in conformity with the dimensions in the preliminary drawing 4.6 Observation of drawing conventions 4.7 Appropriate use of basic commands for CAD software	• Application of rotation techniques: - base point method - reference angle method • Classification of auxiliary views by position: width, height and depth • Production of partial auxiliary views, half auxiliary views, broken-out auxiliary views, auxiliary sections, single and double auxiliary views • Completion of orthographic view using an auxiliary view • Arrangement of auxiliary views
5. Enter dimensions and additional information.	5.1 Accurate calculation of dimensions 5.2 Observation of dimensioning standards 5.3 Accurate use of symbols	• Graphical conventions and orientation of dimensions • Location of dimensions on views • Selection of dimensions to be included • Ordering of components by importance: - manufactured components - standard components

Specifications	Performance Criteria	Suggested Related Content
6. Check the drawing.	6.1 Observation of procedure for checking and approving drawing 6.2 Conformity of drawing with initial data	• Taking the point of view of the user of the drawing and asking: - if the drawing gives a good overall idea of the component - if a worker can easily imagine all sides of the component without seeing the details • Checks to be made: - sufficient number of views; - accuracy of dimensions (using conventional or electronic measurements and a calculator, including the "overall dimensions" to ensure that the worker does not need to perform calculations before manufacturing the component - accuracy of tolerances and recognition of the impact of tolerances on production costs - indication of finish for each surface - specification of materials for each component - clearances for component assembly - title block - parts list corresponding to parts in drawing - explanatory notes - spelling

Specifications	Performance Criteria	Suggested Related Content
7. Print drawings using a plotter.	7.1 Appropriate preparation of materials and plotter 7.2 Determination of appropriate parameters 7.3 Correspondence between parameters and finished print 7.4 Correspondence between printed lines and scaled dimensions	• Information on plotter: - necessary precautions - turning on the plotter - paper position • Determination of printing parameters for a drawing: - units - starting point - paper size selection - drawing rotation - scale - adjustment of print head according to type of paper used • Selection and installation of all materials needed for printing
8. File documents.	8.1 Appropriate document management 8.2 Appropriate selection of filing method	• Use of appropriate file commands, including: - *copy*, *move, save*, *save as* • Use of file compression software such as: *Arj, PKzip, Winzip* • Copying files to various directories, on the network, onto diskettes

MODULE 7: ILLUSTRATING FASTENERS		CODE: 872 364 60 HOURS
Expected Behaviour	**Conditions for Performance Evaluation**	**Suggested Approach**
Illustrate fasteners.	• Given an existing mechanism, a drawing, a catalogue or a sketch • Using relevant technical documentation • Using a computerized work station equipped with drafting software and an electronic library	• Introduce students to the consultation and interpretation of the information contained in catalogues on how to install, describe and represent fasteners. • Organize catalogues to form a reference library. • Prepare a presentation of various kinds of fasteners to allow students to examine them at close hand. • Encourage students to use electronic data bases when drawing certain parts of threaded components. • Emphasize that representations of threaded components must comply with Canadian and US standards: - threads must be shown using pictorial, schematic or simplified representations - representations of V-shaped threads must be schematic or simplified - particular attention must be paid to identifying threads • Ensure that students acquire the relevant technical vocabulary in French and English. • Update the content to reflect technological changes affecting fasteners.

Specifications	Performance Criteria	Suggested Related Content
1. Identify fasteners on a drawing or an existing mechanism.	1.1 Proper designation of fasteners in French and English 1.2 Correct classification of fasteners by form and use	• Designation of fasteners • Forms and uses of fasteners: bolts, screws, nuts, studs, nut-locking elements, pins, staples, washers, retaining rings, rivets, cotter pins, springs, anchors
2. Search for features of different fasteners in technical documentation.	2.1 Efficient location of information 2.2 Accurate identification of features 2.3 Accuracy of - terminology - abbreviations - standards codes	• Meanings of terms, abbreviations and codes used to describe various fasteners • Order of presentation of the information contained in the descriptions • Use of tables and other reference documents • Recognition and calculation of standardized threads, including: - sharp "V" - American national - unified - ISO metric - acme - *Whitworth Standard* - knuckle - buttress

Specifications	Performance Criteria	Suggested Related Content
3. Draw fasteners.	3.1 Accuracy of calculations 3.2 Accuracy of drawing and use of symbols 3.3 Observation of drawing standards and conventions 3.4 Optimum use of software commands	• Method to be used in representing the fasteners listed in specification 1 • Representation of threaded fasteners using the following methods: - pictorial - schematic - simplified • Use of data from an electronic library
4. Download fasteners from an electronic library.	4.1 Correct selection of fasteners from library according to the needs of the drawing, whether - pictorial - schematic - simplified 4.2 Optimum use of software commands 4.3 Relevant adaptation of downloaded fastener, according to scale of drawing	• Use of appropriate CAD software commands to search for the required components • Use of appropriate CAD software commands to download or insert the required components or threads
5. Indicate dimensions and additional information.	5.1 Accurate dimensions, in compliance with standards 5.2 Observance of identification standards to indicate fasteners 5.3 Uniform identification: - using metric or imperial measurements - in French or in English	• Transfer of information from tables and other reference documents • Graphical techniques and orientation of dimensions • Arrangement of dimensions in drawing • Selection of dimensions • Ordering of components by importance: - manufactured components - standard components • Placement and content of title block

MODULE 8: ILLUSTRATING THE ARRANGEMENT OF COMPONENTS	CODE: 872 373 45 HOURS	
Expected Behaviour	**Conditions for Performance Evaluation**	**Suggested Approach**
Illustrate the arrangement and movement of the components of a mechanism.	• Given a range of actual mechanisms comprising at least one sub-assembly of speed reduction or speed variation gears, pumps or small motors • Using materials commonly used for sketching • Using relevant technical documentation	• Encourage workshop or laboratory work using actual mechanisms that students can dismantle and reassemble, observing how the components fit together and how the mechanism moves. • Use different types of mechanisms. • Vary the approach by introducing drawings of mechanisms. • Develop students' spatial perception by encouraging them to envision the layout and movement of components mentally. • At the end of the module, students should be able to explain the composition and operation of the object, a skill they will use in most of the following modules to understand a component before drawing it. • During the performance evaluation, make sure that students assemble the components correctly and give accurate explanations of their role in the mechanism.

Specifications	Performance Criteria	Suggested Related Content
1. Identify the components of a mechanism.	1.1 Precise differentiation of the various types of components 1.2 Correct grouping of components by form and dimension	• Use and correct application of basic tools to dismantle and reassemble units • Dismantling and reassembly processes, assembly diagram • Recognition of shapes such as triangles, quadrilaterals and polygons • Recognition of solids such as polyhedrals, prisms, cylinders, cones and spheres • Metric and imperial systems of measurement • Whole numbers, fractions and decimals • Linear and angular dimensions
2. Represent the position and orientation of components, fasteners and the components of power train systems.	2.1 Logical description of the static role of each component in the mechanism 2.2 Precise determination of the position and orientation of each component 2.3 Accuracy of the sagittal graph representing assemblies and sub-assemblies	• Grouping of components by form and dimension • Determination of the position and orientation of components • Ordered identification of components by number • Layout and content of sagittal graph
3. Represent component movement.	3.1 Logical description of the dynamic role of each component in the mechanism 3.2 Correct determination of the relationships between components 3.3 Clarity of sketch representing movements	• Types of movement: - linear - angular - circular - intermittent - oscillating • Types of static or dynamic components • Description of types of movement
4. Represent the relationship between the components in a perspective sketch.	4.1 Accuracy of proportions 4.2 Exact positioning of components in sketch	• Freehand sketch in isometric or oblique perspective • Assembly drawing of complete or partial mechanism in pictorial or sectional view

MODULE 9: INTERPRETING TECHNICAL INFORMATION ABOUT MATERIALS AND MANUFACTURING PROCESSES **CODE: 872 386 90 HOURS**

HARMONIZATION:
This module is equivalent to Module 7 of *Machining Techniques* (DVS).

Expected Behaviour	Conditions for Performance Evaluation	Suggested Approach
Interpret technical information about materials and manufacturing processes.	• Related to metallic, non-metallic and composite materials • Using technical documentation in English and French: - technical drawings - reference manuals relating to materials, such as *Machinery's Handbook* - catalogues of ferrous products - data sheets, tables and standards, such as *ANSI*, *SAE*, *ASTM* and *CSA*	• After giving a brief historical overview of changes in manufacturing techniques, explain the stages in the manufacture of a given component. • Describe the processes used to obtain raw materials. • Use illustrations or audio-visual materials to expand the theoretical presentation. • Distribute samples of various materials to allow students to handle them and learn to differentiate between them on the basis of texture, colour and weight. • Ask students to carry out research on manufacturing processes. • Organize a visit to a machine shop to allow students to experience the manufacturing process and understand how technical drawings are used. Ensure that the visits are properly organized and conducted by competent staff from the machine shop. Other visits can also be organized to plants specializing in various processing techniques. • Resistance calculations should be limited to stresses and deformations in mechanical components rather than structures, such as the shearing of a cotter pin or a bolt, the deformation of a rod, etc.

Expected Behaviour	Conditions for Performance Evaluation	Suggested Approach
		• Since this is a theoretical module, the evaluation should test students' practical knowledge concerning the links between technical drawings and: - the materials used to make components; - calculations of the resistance of certain materials; - manufacturing processes. • Ensure that students acquire the relevant technical vocabulary in French and English.

Specifications	Performance Criteria	Suggested Related Content
1. Describe the materials specified in technical drawings.	1.1 Proper identification of the types of materials used to make components 1.2 Accurate reading of the physical, mechanical and chemical properties of materials, as found in technical documentation 1.3 Accurate interpretation of Canadian, American and international material identification codes 1.4 Accurate interpretation of working stresses as defined in tables 1.5 Summary calculation of the resistance of the materials used to make a component	• Description of stages in the process of obtaining and manufacturing cast iron and steel: extraction, crushing, smelting, rolling, and grading, blast-furnaces and converters. • Recognition of materials: - ferrous metals: cast iron, steel - non-ferrous metals: aluminium copper, zinc, magnesium, lead, tin, nickel, tungsten - alloys: stainless steel, brass, bronze - plastics: nylon, Teflon, Bakelite, glass fibre, rubber • Physical, mechanical and chemical properties, including: tenacity, solvability, wear resistance, corrosion resistance, density, conductibility, expansion, thermal contraction, ductility and malleability • Standardized symbols (hatching) for materials • Metal codes • Determination of material resistance to certain forces • Behaviour of metals subjected to certain forces • Demand, effort, charge, elasticity, resistance, rigidity, ductility, malleability, limit of elasticity, limit of resistance, breaking point, elasticity module, loads, stresses, coefficient of expansion • Metric and imperial units used to measure length, volume, mass, time, temperature • Conversion of imperial to metric measurements and vice versa

Specifications	Performance Criteria	Suggested Related Content
2. Recognize types of surface finishes and component tolerances.	2.1 Accurate interpretation of symbols 2.2 Correct association between surface finishes and corresponding tolerances	• Application of formulas to determine different types of stress (tension, flexion, compression, shearing, torsion) • Location of working stress data in tables • Interpretation and representation of ACNOR, ASA and ISO symbols • Interpretation and representation of roughness indexes • Interpretation of the table showing roughness indexes for specific processes • Application of formulas to determine deformation
3. Differentiate among processing methods presented in the documentation.	3.1 Correct recognition of the features of the following processes: - moulding - shaping - machining - welding - assembling - sintering 3.2 Appropriate establishment of links between processing methods and applications in various fields	• Sand casting, plaster moulding, wax casting, intrusion moulding, shell moulding, case casting, centrifugation, die casting • Permanent and non-permanent moulds • Pressure moulding, shell moulding, sand casting • Forging, swaging, stamping • Extrusion, fluid cutting, punching, folding, embossing, forming, high energy forming, powder metallurgy and welding • Description of heat treatments: tempering, hardening, annealing, cementation • Description of processing: oxidation and anodization • Description of coatings: plastic coating, painting, rubber coating, plating and metallization

Specifications	Performance Criteria	Suggested Related Content
4. Establish links between the drawn object and its manufacture.	4.1 Relevant links between processes and the machine tools used 4.2 Relevant links between the features of a process and the limits on using a given material 4.3 Relevant links between the manufacturing process and the required degree of precision and surface finish 4.4 Relevant links between surface finishes and thermal treatments	• Motion in a kinematic sequence: rotation, translation, orientation, clearance and free play • Boring machines: portable, fixed, drill press, radial, multiple spindle, drill press • Lathes: parallel, automatic, turret, numerical control and vertical • Horizontal and vertical milling machines • Surface and cylindrical grinders • Boring machine operations: drilling, countersinking, milling, boring, tapping • Lathe operations: turning, facing, knurling, polishing, thread cutting, chamfering • Turning operations: facing, grooving, shaping, chamfering • Grinding operations: surface grinding, cylindrical grinding • Reading of tables for degrees of precision and surface finishing: - degrees of precision: 0.00, 0.000, 0.0000 - degrees of finishing (roughness indexes): 8, 16, 32, 63, 125, 250 - degrees of precision and finishing of various processing methods - degrees of precision and finishing of machining operations (boring machine, milling machine, lathe and grinder) • Association of processing or manufacturing method with symbols representing surface finishes and tolerances

MODULE 10: PRODUCING ASSEMBLY DRAWINGS	CODE: 872 395	75 HOURS

Harmonization:
This module is equivalent to competency 012U of Mechanical Engineering Technology (DEC). The content of Modules 4, 6 and 10 of this program correspond to competency 011U of Aircraft Manufacturing Technology (DEC).

Expected Behaviour	Conditions for Performance Evaluation	Suggested Approach
Produce assembly drawings.	• Related to a drawing of a mechanical object consisting of fasteners and having a maximum of fifteen components • Given sketches and annotated detail drawings in French and English • Using a computerized work station • Using CAD software • Using relevant technical documentation in French and English	• First, instruct the students to examine assembly drawings. • Next, instruct the students to produce assembly drawings related to perspective or exploded views of components. • Last, have students produce assembly drawings using manufacturing (detail) drawings in orthographic projection. • Ensure that students acquire the relevant technical vocabulary in French and English. • Emphasize the importance of selecting the correct way to represent the mechanism. A proper assembly drawing should represent all the components as clearly as possible using a minimum number of views. Redundant projections and details should also be avoided. • Check the following criteria while students are completing their work: - correct orientation and fit of components - use of appropriate standardized lines - accuracy of component identification - spelling

Specifications	Performance Criteria	Suggested Related Content
1. Interpret detail drawings.	1.1 Exact description of the function of each component shown in the drawing 1.2 Accurate recognition of component assemblies 1.3 Accurate description of the function of the object 1.4 Appropriate translation of English technical terms used in the drawing	• Functional examination of the mechanism - operating principles - movements - role of sub-assemblies and major elements • Organic examination of mechanism: specific role of each component or element
2. Organize the work.	2.1 Selection of appropriate reference documents 2.2 Appropriate determination of the orientation of the objects according to: - use - relationship with other objects 2.3 Appropriate choice of views 2.4 Appropriate arrangement of views in sketch form	• Selection of reference documents • Selection of instrument and materials • Conventions to follow in choosing how to orient the drawing of the mechanism • Conventions to follow in selecting and arranging: - sectional views - exterior views - partial views (details, scaled enlargements)
3. Draw the components to be manufactured.	3.1 Correct dimensions and scale 3.2 Exact fit of components 3.3 Appropriate use of specialized CAD software commands	• Differentiation between components to be manufactured and components to be purchased • Orthographic projection drawings • Layout and position of components
4. Insert commercially-available components.	4.1 Effective search in a range of documents, catalogues and electronic media 4.2 Optimum use of specialized CAD software import commands 4.3 Correct dimensions and scale 4.4 Exact fit of components	• Search for information in reference works and catalogues • Electronic libraries and Internet • Representation of components noted in documents and electronic media • Orthographic projection drawings

Specifications	Performance Criteria	Suggested Related Content
5. Insert dimensions and additional information.	5.1 Precise calculation of shape and positioning tolerances 5.2 Observation of dimensioning standards 5.3 Accurate and exhaustive naming of components 5.4 Observance of order of manufacture in parts list 5.5 Accurate entry of assembly information 5.6 Correct use of symbols and names 5.7 Correct completion of title block 5.8 Uniform application of language and system of measurement on drawings in naming components	• Standards relating to component numbering • Ordering of component by importance: - manufactured components - standard components • Identification method for components in drawing: - numerical symbols - alphabetical identification - position of part number • Position of parts list • Content of parts list - part number - quantity - part name - manufacturer and stock number - material - remarks • Position and content of title block
6. Check the drawing.	6.1 Observance of procedure for checking and approving a drawing 6.2 Conformity of drawing with initial data	• Checking of drawing: application of the learning acquired as competency *Produce detail drawings of mechanical components*
7. File and print documents.	7.1 Correct document management 7.2 Appropriate selection of filing method 7.3 Observance of correct printing procedure	• Use of appropriate file commands, including: - *copy, move, save*, *save as* • Use of file compression software such as: *Arj, PKzip, Winzip* • Copying files to various directories, on the network, onto diskettes • Application of the learning acquired as competency *Produce detail drawings of mechanical components*

MODULE 11: USING THE SPECIALIZED FUNCTIONS OF A COMPUTER-AIDED DRAFTING PROGRAM **CODE: 872 407 105 HOURS**

Harmonization:
This module is equivalent to competency 013C of *Mechanical Engineering Technology* (DEC).

Expected Behaviour	Conditions for Performance Evaluation	Suggested Approach
Use the specialized functions of a computer-aided drafting program.	• Given a computerized work station • Using computer-aided drafting software • Using a plotter • Using relevant technical documentation	• This competency is a continuation of *Produce detail drawings of mechanical components*. In this module, students will familiarize themselves with the other program commands and begin 3D drawings. The module will also introduce students to notions relating to the use of an operating system. • Ensure that content is adapted to reflect technological changes. • Ensure that students acquire relevant technical vocabulary in French and English.

Specifications	Performance Criteria	Suggested Related Content
1. Customize the graphical environment of the drafting program.	1.1 Appropriate adaptation of menus, toolbars and keyboard 1.2 Use of appropriate functions	• Customization of toolbars, menus and keyboard shortcuts
2. Control on-screen displays.	2.1 Setting of correct parameters 2.2 Justification of parameters selected 2.3 Appropriate use of advanced program commands	• Determination of dimensions of various types of line segments and spaces • Recognition of geometrical elements such as quadrants, tangents, centres, intersections, etc. • Determination of drawing assistance parameters • Setting of parameters: - *Linetype* - *Color* - *Layer* - *Ltscale* - *Osnaps* - *setvar command* • Doing the drawings: - creation of dotted lines: *pline*, *pedit* - creation of conventional and isometric ellipses: *ellipse* - freehand sketches: *sketch* - calibration of number pad and digitize existing drawings - alteration of drawing elements: lines, dotted lines, points, circles, attributes, arcs, text, solids, polygons, polylines, blocks - changing line and circle dimensions (*change*) - changing insertion point and orientation of blocks and text (*change*) - changing properties: colour, line types, layer, height, thickness (*change*) - *divide*, *measure* - *explode* - *redo* - *pedit*

Specifications	Performance Criteria	Suggested Related Content
		• Use of commands - *Viewers* - *View* - Regenauto
3. Change styles and dimension variables.	3.1 Setting of appropriate dimension parameters 3.2 Conformity of dimension styles with standards for technical drawing 3.3 Appropriate application of dimension techniques for various variables	• Determination of dimension parameters - settings for dimension styles - letter height - general scale factor • Types of dimension: horizontal, vertical, rotated, angle • Application of dimensioning variables • Tolerancing
4. Use a block library.	4.1 Structured organization of existing drawings to form a library 4.2 Appropriate alterations to existing block 4.3 Observance of correct procedure for saving a block as a separate file (using the *Wblock* command, for example) 4.4 Inserting of a drawing as a reference file (using the *Xref* command, for example) 4.5 Optimum use of commands to create, alter and export attributes of existing blocks	• Creation of blocks - effects of layers in blocks - from file - alterations to blocks - changing the insertion point for a block - "explosion" of a block • Block insertion: single or multiple • Insertion using unequal *x* and *y* scales • Creation and alteration of attributes • Use of commands: - to create attributes: *ddattdef* - to edit attributes: *attedit* - to display attributes: *attdisp*
5. Enter hatching lines on a sectional drawing showing several different materials.	5.1 Optimum use of commands 5.2 Observance of drawing conventions and standards for indicating materials	• Hatching lines: - direction and spacing of different line patterns, solid fill pattern • Construction of a closed surface (*region*)

Specifications	Performance Criteria	Suggested Related Content
6. Insert tables and text in a drawing.	6.1 Observance of correct procedure for inserting tables created in other programs, such as word processing and spreadsheet programs 6.2 Optimum use of commands to: - enter text - create paragraphs - create lettering styles - alter text - enter symbols	• *Text*, *Dtext*, *Mtext* • *Qtext* • Entering text: - creation of styles - existing fonts - special characters - "dynamic" text - entering text using a word processing program - entering text using a spreadsheet program
7. Manage drafting program files.	7.1 Correct file extensions 7.2 Observance of correct procedure for - locking files - transferring files from one program to another and one user to another	• DXF, DWF, IGF, IGS, 3DS • Use of *zip* and *arj* formats, etc. • Use of *copy*, *move*, *delete* commands, etc. • File transfer using clipboard
8. Construct 3D shapes using wire-frame or surface modelling	8.1 Accurate differentiation among various 3D drawing modes 8.2 Appropriate selection of coordinates for shape construction (using the *User Coordinate System (UCS)* command) 8.3 Optimum use of commands to create basic surfaces 8.4 Appropriate selection of commands to view results	• Setting of parameters for the 3D environment: top, front, side • Use of UCS coordinates: - set, change, use, alter UCS - world orthographic planes, definition of UCS using a sloping coordinate system plane • Use of *dview*, *camera*, *zoom*, *vpoint*, *distance* • Location and creation of *view ports* • Creation of 3D surfaces: *face*, *pface*, *surftab*, *rulesurf*, *tabsurf*, *REVSURF*, *edgesurf* • Manipulation of rendering: *hide*, *shade*, *render*

MODULE 12: TAKING AND INTERPRETING MEASUREMENTS	CODE: 872 054	60 HOURS

Harmonization:
This module is equivalent to Module 5 of *Machining Techniques* (DVS) and competency 012P of *Mechanical Engineering Technology* (DEC).

Expected Behaviour	Conditions for Performance Evaluation	Suggested Approach
Take and interpret measurements.	• Given: - objects to be measured - assembly or detail drawings in metric and imperial units of measurement • Using measuring instruments and devices • Using various reference materials, such as: - *Machinery's Handbook* - tables and nomographs - conversion tables • Using a scientific calculator • Using inspection records • Using cleaning products and lubricants	• Return to this competency throughout the program in order to establish links with the quality control of parts in the modules related to machining processes. • Use instruments graduated in the metric and imperial systems of measurement. • Demand serious, careful work. • Emphasize the importance of quality control. • Inform the students of their responsibilities in an industry concerned with total quality.

Specifications	Performance Criteria	Suggested Related Content
1. Plan the work.	1.1 Understanding of the context and characteristics of the object to be measured 1.2 Accurate interpretation of the information contained in the drawings: - dimensions - tolerances - instructions 1.3 Appropriate choice of measuring instruments and devices 1.4 Proper positioning of part and choice of fastenings for the part to be measured 1.5 Organized arrangement of instruments and devices	• Graduated measuring instruments: rulers, vernier callipers, micrometers, dial gauges, touch-sensing probes, protractors, bore gauges, etc. • Non-graduated measuring instruments: dividers, square, marking gauge, telescope gauge, etc. • Callipers, jigs and parallels: threads, angles, radii, diameter, taper, roughness index, etc. • Testing instruments: sine bar, sine plate, surface plates, angle plate, parallels, jack, V block, three-wire method, balls, etc. • Testing apparatus: optical comparator, hardness tester, roughness tester and numerical measuring instruments
2. Prepare the measuring instruments and devices, as well as the part to be measured.	2.1 Precise inspection of instruments and devices 2.2 Accurate calibration and adjustment of measuring instruments and devices 2.3 Proper preparation of part 2.4 Cleanliness of work area	• Detection of defects • Neatness • Calibration and adjustment techniques • Manufacturer's standards • Cleaning, deburring, handling, mounting and fastening of part • Test temperature (thermal expansion)
3. Measure parts of different shapes.	3.1 Accurate calculation of information needed for measurement 3.2 Proper use of measuring instruments and devices 3.3 Accurate reading of dimensional and geometric measurements 3.4 Accurate conversion of dimensions in the metric and imperial systems of measurement 3.5 Accurate interpretation of measurements 3.6 Accurate recording of results	• Calculations associated with measurement: offset dimensions, height of gauge blocks, coordinates and conversions • Methods of using instruments and devices: direct reading, transfer of measurements from one instrument to the other and go, no-go gauges • Interpretation of measurements • Inspection records

Specifications	Performance Criteria	Suggested Related Content
4. Inspect the physical characteristics of parts.	4.1 Proper use of measuring instruments and devices 4.2 Accurate readings 4.3 Observance of technique for converting scales 4.4 Accurate recording of results	• Techniques • Optical comparators • Roughness and hardness testers • Hardness scales: Rockwell, Brinell, etc. • Conversion tables for hardness scales • Inches and centimetres • Inspection records
5. Sketch the part.	5.1 Proper choice of views 5.2 Accurate and proportional representation of part 5.3 Accurate recording of dimensioning and relevant information	
6. Perform regular maintenance on measuring instruments and devices.	6.1 Careful cleaning of instruments and devices 6.2 Lubrication of instruments and devices at the appropriate points 6.3 Proper storage of instruments and devices	• Simple assembly and disassembly of components • Products and accessories • Cleaning methods • Lubrication points • Frequency of lubrication • Types of lubricants • Cleanliness • Protection against rust, dust, products, shock, etc.

MODULE 13: DETERMINING DIMENSIONAL TOLERANCES		CODE: 872 414 60 HOURS
Harmonization: **This module is equivalent to competency 012S of *Mechanical Engineering Technology* (DEC).**		
Expected Behaviour	**Conditions for Performance Evaluation**	**Suggested Approach**
Determine dimensional tolerances.	• Related to a mechanical object comprising several components. • Given technical drawings and pre-established data. • Given existing industrial standards. • Using a computerized work station. • Using appropriate technical documentation in French and English.	• Ensure that students acquire the relevant technical vocabulary in French and English.

Specifications	Performance Criteria	Suggested Related Content
1. Gather information.	1.1 In-depth examination of an assembly drawing and detail drawings 1.2 Detailed list of required dimensions	• Assembly drawings • Existing sketches and detail drawings
2. Analyze the functional conditions of the object.	2.1 Complete list of relevant functional conditions 2.2 Accurate determination of parameters relating to material thickness 2.3 Assignment of suitable values for the functional conditions	• Conditions relating to: assembly, thread angle, fit, insertion, etc. • Determination of a value for each condition • Justification of each choice made • Choice of tolerances depending on functional conditions: - tolerance with clearance fit - tolerance with transition fit - tolerance with interference fit - maximum allowable material tolerance Note: Not all the above criteria are used in every case.
3. Establish dimension chains.	3.1 Methodical entry of dimension chains in vectorial form 3.2 Observance of functional conditions when entering dimension chains 3.3 Dimension chains with minimum number of vectors 3.4 Careful entry of dimension chains on tolerance study drawings	• Method for entering dimension chains • Method for entering limit dimensions on tolerance study drawings
4. Establish tolerance values.	4.1 Complete list of tolerances required by manufacturers 4.2 Precise determination of tolerance values based on required tolerances and established dimension chains 4.3 Strict placement of linear tolerances	• Search in component manufacturers' catalogues • Entry of values and tolerances for each component • Determination of tolerance values on the basis of knowledge of manufacturing processes • Placement of tolerances on working drawing

Specifications	Performance Criteria	Suggested Related Content
	4.4 Precise calculation of minimum and maximum linear values on the basis of functional conditions 4.5 Accurate calculation of transfers of linear values 4.6 Careful entry of values and tolerances in the tolerance study drawing file	
5. Enter tolerances on drawings.	5.1 Accurate entry of tolerance values on drawings 5.2 Careful verification of concordance between tolerance values	• Method of entering values on working (final) drawings • Method of verifying concordance between tolerance values

MODULE 14: CORRECTING A DRAWING		CODE: 872 421 15 HOURS
Expected Behaviour	**Conditions for Performance Evaluation**	**Suggested Approach**
Correct a drawing.	• Related to the checking of drawings produced by colleagues • Given a technical drawing containing errors • Using the data on which the drawing was based • Using relevant reference documents • Using a computer-aided drafting program	• Within a business or industry, a draftsperson may be required to correct drawings produced by colleagues. • Encourage students to develop the attitudes needed to give and receive criticism. • Use drawings produced in previous modules, drawings produced by students or drawings supplied by the instructor. • Emphasize: - the consequences of using an incorrect drawing - stress management methods to deal with the responsibilities involved • Introduce the subject gradually - begin with detail drawings produced by the students but not previously corrected - next, ask students to correct drawings containing deliberate errors introduced by the instructor or another student; clues should be given concerning the number and type of errors - last, give students assembly and manufacturing drawings containing errors, but provide no clues. Since the module is short, these drawings should not be too complex • Emphasize the fourth sub-objective of "check the validity of the corrections made" to encourage students to justify their work and present high-quality, error-free drawings.

Specifications	Performance Criteria	Suggested Related Content
1. Analyze drawings and the initial data on which they are based.	1.1 Accurate identification of the components represented in the drawing and their role 1.2 Accurate description of the operation of the mechanism 1.3 Accurate representation of the component in a perspective sketch	• Analysis of the drawing and the initial data, in other words, description of the types of components represented in the drawings, such as - fasteners - power train systems - commercially-available components - components to be manufactured • Application of knowledge on the operation and role of components
2. Gather reference documents for the project.	2.1 Selection of documents 2.2 Relevance of documents	• Selection of documents such as catalogues, tables, technical works and dictionaries
3. Check the drawing.	3.1 Accurate assessment of the items and types of items to be verified 3.2 Logical ordering of the stages in the checking process 3.3 Complete check in the order determined previously 3.4 Accurate and complete reporting of errors and types of errors 3.5 Tidiness 3.6 Accuracy of corrections 3.7 Recognition of the consequences of an unjustified correction	• Importance of applying a quick, effective method to make sure that - no corrections are omitted - no corrections are repeated • Determination of items to be checked and possible errors in calculations, dimensions, description, projections (views) • Determination of the type of check: - quality of views, sections and lines - repetition, ambiguity, legibility, omissions and numerical values - content and legibility of special and general notes • Ordering of stages • Application of the stages in order • Determination of the consequences of errors contained in the drawing • Consequences on the cost of the design, manufacture and cost of the component • Creation of signs and symbols and lettering • Use of colours • Indication of errors in the drawing • Recognition of different types of error • Use of correction code

Specifications	Performance Criteria	Suggested Related Content
4. Check the validity of the corrections made.	4.1 Matching of the corrections made with drawing standards and initial data 4.2 Consideration of the consequences of a faulty check	• Comparison of corrections made with initial data
5. Give and receive criticism on corrections to be made.	5.1 Accuracy of the information communicated 5.2 Accuracy of the technical terms used 5.3 Tact 5.4 Positive attitude to criticism	• Application of the module *Adapting to the new types of work organization*
6. Alter a drawing.	6.1 Observance of correct procedure for altering a drawing 6.2 Accuracy of alterations 6.3 Clear, accurate entry of alterations	• Alterations to dimensions • Addition of the revision symbol • Revision table

MODULE 15: ILLUSTRATING POWER TRAIN SYSTEMS		CODE: 872 436 90 HOURS
Expected Behaviour	**Conditions for Performance Evaluation**	**Suggested Approach**
Illustrate power train systems.	• Given an existing mechanism, a drawing, a catalogue or a sketch • Using relevant technical documentation • Using a computerized work station equipped with a drafting program and databases	• Most power train systems are commercially supplied, and representations are taken from catalogues and show little detail. However, the representation of certain power train systems such as gears and cams requires more detail, as do assembly drawings for anti-friction pads. • Bring the documentation together to form a reference centre. • Encourage students to collect books and catalogues provided free of charge by companies, to establish an information bank that will help them throughout their studies and when they enter the labour force. The instructor should show students how to interpret the information contained in the documents correctly, to maximize their usefulness. • The instructor should bring actual components to class to facilitate students' understanding by allowing them to handle them directly. • Classroom instruction should be supplemented by the use of audio-visual materials. • The difficulty of the exercises should be graduated. For example, instead of asking students to produce a complete drawing of two engaged conical gearwheels, complete with teeth, they should be asked to produce a conventional representation of gearwheels. Cam drawings should include a graphical representation of cam movement as it relates to speed. • Ensure that the students recognize power train systems and features accurately. • Ensure that students acquire the relevant technical vocabulary in French and English. • Adjust content to reflect technological developments.

Specifications	Performance Criteria	Suggested Related Content
1. Identify power train systems on a drawing or in an existing mechanism.	1.1 Naming of power train systems using appropriate French and English terminology 1.2 Classification of power train systems by type and use	• Naming of power train systems • Classification by shape, dimensions and use of - belts, chains, gear assemblies, perpetual screws, flexible shafts, speed regulators, speed reduction units, couplings, clutches, brakes, cams, friction pads, plummer blocks, bearings, seals and guide systems
2. Search for power train features in technical documentation.	2.1 Efficient location of information 2.2 Accurate listing of power train features 2.3 Accuracy of - terminology - graphical abbreviations - company codes and standardized codes	• Recognition of different power train systems and related calculations • Meaning of terms, abbreviations and codes used to describe power train systems • Order of presentation of information in descriptions • Use of tables and other reference documents to search for: - belts, chains, gear assemblies, perpetual screws, flexible shafts, speed regulators, speed reduction units, couplings, clutches, brakes, cams, friction pads, plummer blocks, bearings, seals and guide systems • Application of learning from the module *Solving problems related to industrial drafting* to calculate the force, effort and power of power train systems • Units used (imperial and metric systems) • Description of intensity, point of application, direction and thrust • Types of forces: colinear, parallel • Parallelogram, polygon and triangle methods • Catalogue searches • Database searches

Specifications	Performance Criteria	Suggested Related Content
3. Perform calculations.	3.1 Accuracy of calculations to determine - gear and torque ratios - centre-to-centre distances - dimensions 3.2 Use of appropriate formulas	• Application of knowledge from the *Solving problems related to industrial drafting* module • Application of formulas to determine rations, speeds, centre-to-centre distances and dimensions • Presentation of calculations • Calculations related to - standard belts and pulleys (V flat toothed) - standard gear trains - gears: cylindrical, spur, bevel, mitre, helical - worm gears - disk and cylinder cams producing straight-line, back-and-forth and parabolic motion
4. Draw power train systems.	4.1 Concordance between drawings and calculations 4.2 Accuracy of drawings and symbols 4.3 Observance of drawing standards and conventions 4.4 Optimum use of software commands	• Symbolization of power train systems • Selection of elements to be represented • Representation of components listed in Specification 2 • Transfer of information from tables and other reference documents
5. Import power train systems from electronic libraries.	5.1 Optimum use of program commands 5.2 Appropriate adaptation of imported power train system to scale of drawing	• Use of correct CAD program commands to perform search for components • Use of correct CAD program commands to import or insert blocks or files
6. Enter dimensions and additional information	6.1 Accurate dimension in compliance with standards 6.2 Conformity of notation with technical documentation 6.3 Observance of conventions for naming power trains systems 6.4 Uniformity of notations: - in metric or imperial systems - in French or English	• Application of content of Specification 5 of *Illustrating fasteners* regarding dimensioning.

MODULE 16: PRODUCING DEVELOPMENT DRAWINGS	CODE: 872 446	90 HOURS

Harmonization:
This module is equivalent to competency 013B of *Mechanical Engineering Technology* (DEC).

Expected Behaviour	Conditions for Performance Evaluation	Suggested Approach
Produce development drawings.	• Related to conventional and computerized drawings • Related to the development of mechanical components for industry • Given a detail drawing with annotations in French or English and corresponding data. • Using a computerized work station equipped with a plotter • Using a drafting or development program	• Industrial draftspersons may be required to work in firms producing ducts, metal furniture and other technical objects produced by bending sheet metal. • Ensure that students master techniques using a drawing-board before beginning work using a computer program. Adapt teaching and learning strategies and content to reflect technological changes. • Begin by explaining principles and "why," before going on to "how." • Ask students to complete a 3D model of certain developments using thin cardboard in the plotter. A visit to a plant where components are manufactured from sheet metal (for example, heating or ventilation ducts) will allow students to understand the practical applications of development drawings.

Specifications	Performance Criteria	Suggested Related Content
1. Organize the work.	1.1 Accurate interpretation of the preliminary drawing and corresponding data 1.2 Accurate and proportional sketch of the component 1.3 Appropriate preparation of material and work station	• Appropriate preparation of drawing instruments and work station
2. Draw the object in orthographic projection.	2.1 Correct arrangement of views 2.2 Conformity of drawing with initial data 2.3 Observance of dimensions 2.4 Accuracy of drawing	• Draw geometric figures: - triangles, rectangles, pentagons, octagons, hexagons, octagons, circles and ellipses - solids, prisms (right and oblique), cylinders (right and oblique) cones (right and oblique), truncated cones, pyramids (right and oblique), truncated pyramids • Drawing of objects that may comprise components such as: - prisms (right and oblique), cylinders (right and oblique), 90-degree elbows, cones (right and oblique), truncated cones, pyramids (right and oblique), truncated pyramids - transition segments in circular-to-circular, rectangular-to-circular, and offset circular forms • Application of drawing techniques learned in previous modules

Specifications	Performance Criteria	Suggested Related Content
3. Draw the intersection of parts.	3.1 Observance of construction methods in determining line intersections 3.2 Exact designation of lines 3.3 Accurate position and length of construction lines 3.4 Conformity of lines with construction lines	• Drawing of construction lines to determine the intersection of the following components: - two prisms (right and truncated) - cylinder and prism (right and truncated) - two cylinders (right and truncated) - cone and prism - cone and cylinder - pyramid and prism - pyramid and cylinder • Application of construction methods: - for auxiliary sections - for auxiliary views - for reference points • Line layout • Line identification sequence
4. Project construction lines.	4.1 Observance of construction methods in determining the shapes of the development 4.2 Accuracy of calculations 4.3 Precise determination of extra allowance required for bending thick materials 4.4 Exact designation of lines for various constructions 4.5 Exact position and length of construction lines	• Drawing of component intersections: - joining of construction lines by straight or curved lines - application of the following methods to determine the true length of a line - rotation - auxiliary view - diagram of true length • Application of mathematical notions and formulas to calculate surface, perimeter, circumference and bend allowance

Specifications	Performance Criteria	Suggested Related Content
5. Draw the shapes of the development.	5.1 Correspondence of linework with construction lines 5.2 Exact designation of points bordering the linework 5.3 Accurate representation of fasteners 5.4 Careful work	• Drawing of construction lines to determine the shapes of the development of the parts for the following shapes: - prisms (right and truncated) - cylinders (right and truncated) - 90-degree elbows (right) - cones (right and truncated) - truncated cones - pyramids (right and truncated) - truncated pyramids - transition segments: - circular to circular - rectangular to circular - offset circular • Application of construction methods: - parallel straight lines for prisms and cylinders - radial straight lines for cones and pyramids - triangulation for oblique cones an transition segments • Joining of projected or carried over lines • Identification of the points forming the line
6. Enter dimensions and additional information.	6.1 Accurate dimensions, in compliance with standards 6.2 Accuracy of notes and information in title block	• Application of learning acquired in the modules on detail drawings and assembly drawings - drawing techniques and orientation of dimensions - arrangement of dimensions - selection of dimensions - location and content of title block

Specifications	Performance Criteria	Suggested Related Content
7. Produce a development drawing using development software.	7.1 Accurate determination of arrangement of parts on raw material to optimize material use during cutting 7.2 Accuracy of data entered in program 7.3 Appropriate use of basic software functions 7.4 Accuracy of dimensions and information entered on drawing 7.5 Determination of appropriate parameters for printing with plotter	• Data entry - Use of commands
8. Check the drawing.	8.1 Observance of correct procedure for checking and approving drawing 8.2 Conformity of drawing with initial data 8.3 Correct completion of check model 8.4 Correspondence between model and initial data	• Application of learning acquired in the module *Producing detail drawings of mechanical components* concerning the verification of drawings
9. File documents.	9.1 Appropriate document management 9.2 Appropriate choice of filing method	• Application of learning acquired in the module *Producing detail drawings of mechanical components* concerning the filing of drawings

MODULE 17: MAKING A THREE-DIMENSIONAL MODEL OF AN OBJECT	CODE: 872 456	90 HOURS

HARMONIZATION:
This module is equivalent to competency 013D of *Mechanical Engineering Technology* (DEC).

Expected Behaviour	Conditions for Performance Evaluation	Suggested Approach
Make a three-dimensional model of an object.	• Related to the three-dimensional modelling of an object • Related to an object comprising a set of components • Given an orthographic drawing or sketch. • Using 3D software	• Students must master a computer-aided drafting program before beginning this module. • Drafting programs are no longer just an electronic simulation of a drawing board. They allow ideas to be presented more clearly and illustrated in greater detail, and they are also making rapid progress in the area of 3D modelling. • 3D work has become an integral part of the design process, and it should be used every time more than one view is required to represent and explain a component. 3D models are the basis for computer-aided manufacturing (CAM) and renderings.

Specifications	Performance Criteria	Suggested Related Content
1. Plan the work.	1.1 Correct selection of method: - basic shapes in two dimensions - basic solids in two dimensions 1.2 Correct planning of the 3D construction sequence 1.3 Appropriate alteration of the layer variables 1.4 Observance of proportion in the sketches	• Insertion of basic shapes and solids: - *box* - *sphere* - *cylinder* - *cone* - *wedge* - *torus* • Use of commands *line*, *pline* and *pedit* to create extrusions • Creation of extrusions using *path*
2. Construct the parts of the object.	2.1 Correct creation of the basic solids making up the drawing 2.2 Accurate extrusion of irregular shapes 2.3 Optimum use of commands to join and separate 2.4 Appropriate alterations to existing shapes: - fillet - chamfer 2.5 Appropriate choice of 3D program commands	• Revolving of 2D shape: *revolve* • Joining of solids (union) • Separation of solids • Commands to change solids: *chamfer* and *fillet* • Commands: *copy*, *move*, *3D array*, *3D mirror*, *3D rotate* • Construction of solids using commands: *region*, *boundary*, *intersect*

Specifications	Performance Criteria	Suggested Related Content
3. Assemble the parts of the object.	3.1 Appropriate insertion of reference files and blocks to form an exploded view 3.2 Observance of reference points when performing insertion	• Insertion of various elements of a technical object using commands learned in previous modules: *blocks*, *Wblocks*, *Xref* • Planning of insertion points in earlier drawing to assemble the various elements accurately
4. Lay out the page.	4.1 Appropriate positioning and arrangement of drawing on the sheet 4.2 Appropriate choice of views and sections 4.3 Appropriate monitoring of layer visibility in the viewports 4.4 Correct positioning of dimensions in the drawing 4.5 Appropriate monitoring of the visibility and density of the mesh	• Use of commands: - *slice* - *section* - *solview, soldraw* - *interfere* - *solprof* • *Dispsilh*, *isolines*, *facetres*

Specifications	Performance Criteria	Suggested Related Content
5. Display and print a rendering.	5.1 Appropriate arrangement of viewpoints 5.2 Appropriate assignment of materials and colour 5.3 Appropriate choice of background light: *point light*, *distant*, *spot*, *ambiant* 5.4 Accurate definition of parameters to add precision to rendering 5.5 Appropriate determination of file extension 5.6 Observance of correct printing procedure	• Use of commands: - *hide* - *shade*, *shadedge* • Rendering: - *scene to render* - light - materials - shading - *background* - *map* • *Viewres* • Manipulation of various image files such as *gif*, *tif* and *tga* files
6. Animate objects on-screen, with a script file.	6.1 Appropriate choice of commands to create and view slides 6.2 Correct script file to allow automatic presentation of slides.	• Use of commands: - *Vslide* - *Mslide* - *delay* - *script* - *rescript* - *resume*

MODULE 18: PRODUCING DETAIL DRAWINGS OF A MECHANISM		CODE: 872 466 90 HOURS
Expected Behaviour	**Conditions for Performance Evaluation**	**Suggested Approach**
Produce detail drawings of a mechanism.	• Related to a simple mechanism comprising parts to be manufactured, fasteners and a power train system • Given assembly drawings and sketches with annotations in French and English • Using a computerized work station • Using CAD software • Using relevant technical documentation in French and English	• Students must make sketches and determine functional dimensions. In the latter case, the instructor may provide a few reference dimensions to help the students begin their work, which will also make correction easier. • Apply the learning acquired in previous modules. When interpreting the design drawings, the instructor can review the question of the position and role of various parts of a mechanism. • Students should be given assembly or design drawings on a 1:1 scale. The use of a large scale drawing is an advantage because it makes it easier for students to interpret content and note measurements. • During the module, the instructor should emphasize: - concordance of views - concordance of dimensions from one part to another • Students who master the competency before the others should be given more difficult drawings of: - mechanisms with more parts or parts of more complex shape - mechanisms with more complex operations.

Specifications	Performance Criteria	Suggested Related Content
1. Interpret design drawings for a mechanism.	1.1 Differentiation between the types of drawings provided: diagrams, sketches, detail drawings, assembly drawings, layout drawings, catalogue illustrations 1.2 Accurate description of the function of the mechanism represented 1.3 Accurate listing and description of the various parts of the mechanism 1.4 Accurate description of the kinematic sequence of the mechanism 1.5 Appropriate description of the conditions of operation of the mechanism 1.6 Exact location of functional dimensions 1.7 Appropriate translation of English technical terms from the drawings	• Application of learning from module 8, *Illustrating the arrangement of components* and Module 9, *Interpreting technical information about materials and manufacturing processes* in connection with: - A functional examination of the mechanism: - principle of operation - kinematics - role of sub-assemblies and major elements - The organization of the mechanism: - specific role of each part or element - materials - shapes and dimensions of parts and elements
2. Organize the work.	2.1 Selection of relevant reference documents 2.2 Functional and ergonomic organization of the work station	• Recognition of ACNOR standardized sheet sizes • Relations between various formats • Selection of reference documents • Preparation of instrument for sketching and adjustment of work station • Recognition of various drawings for a project: - sketches and diagrams - design drawings, manufacturing drawings, assembly drawings, layout drawings and catalogue illustrations • Description of the features of design and manufacturing drawings • Position of elements on the page, scales used • Content and format of title block and update block, position of title block • Search for the dimensions of standard commercially-available parts in tables and catalogues

Specifications	Performance Criteria	Suggested Related Content
3. Produce sketches.	3.1 Appropriate choice of views 3.2 Appropriate choice and arrangement of sections 3.3 Correspondence between sketches and design drawings as regards part dimensions and shape 3.4 Accuracy of basic dimensions and annotations 3.5 Accurate calculation of functional dimensions 3.6 Accurate entry of functional dimensions on drawing 3.7 Exact designation and symbolization of materials and surface finishes	• Application of learning from Module 4, *Producing sketches* • Drawing, dimensioning and annotation of sketches of parts • Choice and arrangement of orthographic views • Arrangement and symbolization of details • Location of functional dimensions: - choice of operating conditions - location of functional dimensions • Use of a drawing file library and Internet databases
4. Draw exterior views of components of mechanism.	4.1 Correspondence between components and sketch 4.2 Insertion of relevant elements from databases 4.3 Concordance of exterior views 4.4 Arrangement of details in conformity with dimensions indicated 4.5 Appropriate use of specialized CAD program commands	• Drawing of exterior view • Computer drawing
5. Draw sectional views.	5.1 Concordance of various sectional views 5.2 Correspondence between sectional views and exterior views 5.3 Arrangement of details in conformity with dimensions 5.4 Appropriate use of specialized CAD program commands	• Drawing of sectional views • Choice and arrangement of orthographic views
6. Enter dimensions and additional information.	6.1 Accuracy of dimensions, functional dimensions and information entered 6.2 Entry of correctly spelled information using standardized language	• Selection of information: dimensions, notes, etc. • Types of parts: fasteners, power train systems • Determination of functional dimensions • Choice of fasteners

Specifications	Performance Criteria	Suggested Related Content
		• Determination of dimension accuracy (number of decimal places) • Calculation of values and use of tables • Determination of materials and surface finishes • Choice of materials and surface finishes • Designation and symbolization of materials and surface finishes • Use of a single language
7. Check the drawing.	7.1 Observance of procedure for checking and approving a drawing 7.2 Conformity of drawing with initial data	• Application of learning from Module 6, *Producing detail drawings of mechanical components*
8. File the drawings.	8.1 Appropriate document management 8.2 Appropriate choice of filing method 8.3 Observance of printing procedure 8.4 Observance of folding standards for printed drawings	• Use of appropriate AutoCAD file commands: *save* and *save as*, copying and moving files on the hard drive • Use of file compression commands for *zip*, *winzip* and *arj* files • Copying of files in various folders, on the network, on diskette • Paper document filing methods: alphabetical, numerical, alphanumerical • Paper document filing using various methods: horizontal drawers, vertical filing cabinets, pigeon holes

MODULE 19: MAKING PIPING AND CIRCUIT DIAGRAMS		CODE: 872 476 90 HOURS
Expected Behaviour	**Conditions for Performance Evaluation**	**Suggested Approach**
Make piping and circuit diagrams.	• Related to electric, pneumatic and hydraulic circuits • Related to industrial piping. • Related to orthographic and perspective diagrams • Given initial data for a project • Using a computerized work station, connected to the Internet • Using software adapted to each type of circuit • Using relevant technical documentation in French and English	• Use examples from industry rather than from buildings. The diagrams could, for example, relate to pumping and cooling circuits and instrument and control circuits. The time available for the module allows only the essential diagramming skills to be developed. • Ask students to make diagrams using sketches and initial data. • The following plan can be used to introduce new difficulties gradually: - copy existing diagrams - replace notes on a circuit diagram by appropriate symbols - complete incomplete diagrams (missing components) - rearrange components in a diagram, in a logical and more pleasing arrangement (all symbols already indicated) - replace the components of a hydraulic or pneumatic circuit to change the operation of the circuit. • During the module, ensure compliance with the following criteria: - use of appropriate symbols - observance of standard symbols - clear, balanced presentation.

Specifications	Performance Criteria	Suggested Related Content
1. Organize the work.	1.1 Appropriate selection of documents 1.2 Functional arrangement of the computerized work station	• Use of reference documents related to each type of system examined during the module • Organization of a computerized work station
2. Interpret initial data.	2.1 Accurate identification of the components of each circuit and related symbols 2.2 Summary description of the electrical, pneumatic and hydraulic principles underlying the initial data 2.3 Accuracy and exhaustiveness of the information collected on the component of each circuit as regards: - model - capacity - technical features - operation	• Presentation of hydraulic and pneumatic principles: - Pascal, Boyles-Mariotte and lever principles - conservation of energy - multiplication of force • hydraulics and pneumatics terminology: - pressure, force, work, power, fluid velocity, fluid column pressure, atmospheric pressure • Definition of electrical terms such as volt, ampere, watt, resistance, alternating current, direct current • Recognition of the main standard symbols used in electrical diagrams • Symbols for electrical elements: - conductor, connection, energy source, switch, resistor, lamp, transformer, transducer or coil, protection device, wire or conductor • Recognition of the main standard symbols used in piping diagrams: - pipe, valve, cock, joint, sleeve, tee, reducer, plug, elbow, cross, cap, support, anchor • Recognition of the main standard symbols used in drawings of pneumatic and hydraulic systems: - tank, pump, filter, pipe, control, receiver, cylinder, motor

Specifications	Performance Criteria	Suggested Related Content
3. Determine circuit and piping components.	3.1 Efficient location of information from technical documentation 3.2 Appropriate calculations 3.3 Accurate conversion of initial data from metric to imperial measurements and vice versa 3.4 Appropriate choice of components on the basis of the initial data and calculations	• Organic and functional examination of the systems discussed in the module • Recognition and designation of system components in French and English • Naming of system elements • Search in reference sources for components features: - model - capacity - technical specification - operation
4. Make diagrams.	4.1 Accuracy of calculations and conversions 4.2 Appropriate choice of type of diagram and projection 4.3 Arrangement and orientation of the elements of each circuit in the system 4.4 Use of appropriate lines 4.5 Observance of proportions and drawing standards 4.6 Correct use of symbols for each type of circuit	• Standard colour codes used in pneumatics, hydraulics and electricity • Conventions observed in orienting diagrams • Component symbols • Sequence observed in arranging circuit elements • Types of lines used • Orthographic, perspective (oblique isometric) and exploded views in the same diagram • Differentiation among various types of diagrams: simplified, single-line, connection, wiring, printed circuit, block • Pneumatic and hydraulic diagrams: sectional, figurative, simplified and combined • Piping diagrams: single and dual lines • Interpretation of standard colour codes used in pneumatics and hydraulics

Specifications	Performance Criteria	Suggested Related Content
5. Enter dimensions and notes on diagram.	5.1 Accuracy and correct location of dimensions 5.2 Accuracy of notes 5.3 Appropriate location of notes and part numbers 5.4 Uniform notes: - in French or in English - metric or imperial systems of measurement	• Types of notes: - numbering - description • Rules governing the arrangement of notes and part numbers
6. Establish the parts list.	6.1 Appropriate location of parts list 6.2 Accuracy and exhaustiveness of data entered in list 6.3 Accurate use of French and English terminology	• Rules governing arrangement of parts list • Content of parts list: stock number, quantity and description
7. Check the quality of the completed work.	7.1 Observance of steps in checking procedure 7.2 Conformity of diagrams with initial data	• Application of Module 6, *Producing detail drawings of mechanical components* • Check as to necessity of including specification of material for each component • Check of all boxes in title block and parts list to ensure concordance with parts in drawing • Check of explanatory notes • Correction of spelling mistakes

MODULE 20: USING JOB SEARCH OR ENTREPRENEURIAL TECHNIQUES CODE: 872 482 30 HOURS

HARMONIZATION:
This module is equivalent to Module 27 of *Machining Techniques* (DVS).

Expected Outcome	Instructional Guidelines	Suggested Approach
Use job search or entrepreneurial techniques. *Specifications:* Plan the job search or practicum search process. Prepare the required documents. Examine the conditions required to succeed in a selection interview. Explore the possibilities for launching a project or a new business. Assess personal potential and interest regarding entrepreneurship.	• Plan activities likely to interest the students. • Ensure that students understand the importance of beginning a job search with the proper tools. • Provide the students with a range of relevant documentation (reference manuals, brochures, pamphlets, telephone books, videotapes, etc.). • Invite resource persons to speak. • Support students who experience difficulty in meeting their objectives. • Provide students with a sample résumé and letter of introduction. • Allow students to make phone calls during business hours. • Provide the students with a list of questions to help them determine their entrepreneurial profile (suggested reference: Desrosiers et al., *Sensibilisation à l'entrepreneurship*, MEQ). • Create a climate conducive to creativity that allows students to explore different business ideas.	

Specifications	Participation Criteria	Suggested Related Content
PHASE 1: **Information**	- Gather useful information for the job search - Gather relevant information on entrepreneurship and the corresponding personality profile	
(A) <u>Job search</u> • Discovering sources of useful information for preparing a job search		• Employment centres • Weekend newspapers • Professional corporations • Businesses • Acquaintances in the job market • Personal contacts • Placement and recruitment agencies • List of companies in the region • Internet • Other
(B) <u>Entrepreneurship</u> • Learning about the role of entrepreneurship in Québec's economic development.		• Social and economic role of individuals and businesses • Market share of small and medium-size businesses in Québec • Global and export markets
• Learning about the available sources of information on starting a business.		• Brochures from government departments, financial institutions, employment centres, etc. • Reference materials on starting a business • Newspapers and magazines specializing in business, economics, etc. • The Internet
• Learning about the personal characteristics of entrepreneurs.		• Determination, patience, perseverance, leadership, courage, honesty, etc. • Ability to communicate, work long hours, manage personnel, face financial difficulties, adapt to change, manage stress, solve problems, etc. • Competencies

Specifications	Participation Criteria	Suggested Related Content

PHASE 2:
Preparation of the job search or job creation process
	- Summarize the steps involved in
	  - looking for a job
	  - implementing a business project
	- Establish their entrepreneurial profile	

(A) <u>Job search</u>
• Planning the job search process
		• Steps involved
		  - Definition of each student's expectations and needs
		  - Search for potential employers
		  - Production and dispatch of a résumé and letter of introduction
		  - Interviews
		• Follow-up with employers
		• Other

• Writing a résumé and a letter of introduction.		• Résumé:
		  - definition and purpose
		  - qualities (organized presentation, clarity, neatness, etc.)
		  - parts (identification, education and work experience, personality traits, personal experience, activities, references, etc.)
		• Letter of introduction:
		  - definition and purpose
		  - qualities (clarity, neatness, concision, etc.)
		  - parts (date, name and title of addressee, name of company, type of job applied for, justification, request for an interview, address and telephone number, complimentary closing, signature)

• Establishing an employment portfolio.		• Documents to be included • Binding and order of documents

Specifications	Participation Criteria	Suggested Related Content
• Determining the attitudes and behaviours to adopt or avoid in a selection interview.		• Attitudes and behaviours demonstrating competency and main assets • Neat appearance • Appropriate language • Appropriate, coherent remarks • Interest and dynamic attitude • Attitudes and behaviours to avoid
(B) <u>Entrepreneurship</u> • Analyzing the advantages and disadvantages of starting a manufacturing or other type of business.		• Advantages: - job creation - possibility of expansion and diversification - contribution to regional development - self-actualization - management and decision making - other • Disadvantages: - financial investment - risk - responsibilities and workload - personal discipline - compliance with legislation and regulations - other • Self-knowledge • Aptitudes and attitudes • Abilities • Preferences and interests • Other

Specifications	Participation Criteria	Suggested Related Content
• Determining the steps involved in a business plan.		• Determination of type of business and legal status: - sole proprietorship - partnership - corporation - franchise - cooperative - other • Choice of company name • Market study • Government requirements: - licence and permits - municipal regulations - zoning regulations - business tax, GST, QST - income tax - legislation (consumer protection and health and safety) • Development of the organizational structure of the business: - role and duties of staff - business hours • Source of funds

Specifications	Participation Criteria	Suggested Related Content
• Drawing up a list of resources useful when starting a business. • Participating in various activities.		• Financial assistance: - chartered banks and caisses populaires - Business Development Bank of Canada - Ministère de l'Industrie, du Commerce et de la Technologie - Office de la planification et du développement du Québec • Technical assistance: - banks and caisses populaires - chambers of commerce - management consulting firms - Business Development Bank of Canada management consulting service - lawyers and notaries - business leaders - teachers - other • Round-table meetings with entrepreneurs • Viewing of video tapes and discussion on starting a business • Simulated interviews • Readings • Other activities suggested by the instructor

Specifications	Participation Criteria	Suggested Related Content
PHASE 3: **Evaluation of their ability**	• Assess - personal strengths and weaknesses observed while preparing the job search process - personality traits to emphasize or improve - personal potential and interest for launching a business • State means of correcting any deficiencies observed	
(A) <u>Job search</u> • Understanding personal strengths and weaknesses connected with the job search		• Advantages to be gained from self-examination • Genuine assessment of personal strengths and weaknesses • Determination of means to remedy deficiencies • Avoidance of over-severe self-assessment
(B) <u>Entrepreneurship</u> • Assessing their potential for starting a business.		• List of positive and negative personality traits • Assessment of: - the advantages of starting a business and the difficulties involved - their interest and abilities with respect to managing a company - their personal entrepreneurial potential

MODULE 21: PRODUCING DRAWINGS FOR A MECHANICAL SYSTEM		CODE: 872 495 75 HOURS
Expected Behaviour	**Conditions for Performance Evaluation**	**Suggested Approach**
Produce drawings for a mechanical system.	• Work performed alone or in a team • Related to assembly drawings in orthographic projection • Related to a system comprising parts to be manufactured, standards parts, fasteners and power train systems • Related to a system comprising at least fifteen components • Given detail drawings and sketches, annotated in French and in English • Using a computerized work station • Using drafting software • Using relevant technical documentation	• Ensure that technological developments concerning mechanical systems are taken into account. • Have the students sketch the sub-assemblies of a mechanism, to allow them to understand how the parts are arrangement and to prepare them for making drawings of a mechanical system. • The assembly drawings should be made initially using perspective or exploded-view drawings. • Once students have reached a reasonable level of understanding, they should be given manufacturing drawings in orthographic projection. • In all cases, the students' work can be made easier by producing drawings to as large a scale as possible. • Provide students with manufacturing drawings produced by another student, so that they can learn how to remain receptive to remarks made by others and develop the ability to make constructive criticism. • During the module, the following elements should be checked: - correct orientation and arrangement of parts - accurate determination of operating conditions and types of fit - spelling

Specifications	Performance Criteria	Suggested Related Content
1. Interpret detail drawings for the project and technical documentation.	1.1 Accurate description of the function of each part in the system 1.2 Correct understanding of parts arrangement. 1.3 Accurate description of the function of the mechanisms making up the system 1.4 Appropriate translation of English technical terms used in drawings and documentation	• Functional study of the mechanism: - principle of operation - movements - role of sub-assemblies and major elements - organic study of the mechanism: specific role of each mechanism, part or element
2. Organize the work.	2.1 Selection of appropriate reference documents 2.2 Appropriate preparation of the computerized work station 2.3 Determination of the orientation of the mechanism according to - its function - its relation with another mechanism in the system 2.4 Appropriate arrangement of sketched views	• Selection of reference documents • Selection of instruments and materials • Adjustment of the work station
3. Draw parts to be manufactured in three dimensions.	3.1 Concordance of assembly drawing with detail drawings for the project 3.2 Observance of dimensions and scale 3.3 Accurate arrangement of parts 3.4 Appropriate use of specialized 3D commands	• Application of learning from previous modules • Conventions to be observed in orienting the drawing of a mechanism • Conventions to be observed in selecting and laying out sectional, exterior and partial views (details, enlargements) • Differentiation among parts to be manufactured and standard parts • Drawings in orthographic projection
4. Represent standard parts, fasteners and power train components.	4.1 Correspondence between drawings and data given in reference documents 4.2 Observance of dimensions and scale 4.3 Accurate arrangement of parts, fasteners and power train components 4.4 Appropriate use of specialized CAD software commands	• Search for information in reference documents and drawing file libraries • Representations of parts taken from other documents • Insertion of parts from a drawing file library • Drawings in orthographic projection

Specifications	Performance Criteria	Suggested Related Content
5. Represent adjustable parts in the system.	5.1 Appropriate choice of types of adjustment, depending on the mechanism 5.2 Appropriate choice of location for adjustable parts 5.3 Accurate fit of parts	• Determination of location and operating conditions • Association of compatible parts • Determination of type of adjustment • Presentation in table form, and as dimensions on drawing
6. Enter dimensions and additional information.	6.1 Accuracy of dimensions for part movement 6.2 Accuracy of method used to designate parts on drawing 6.3 Accuracy of dimensions according to standards 6.4 Accuracy and clarity of annotations and information contained in parts list and title block 6.5 Correct ordering of annotations 6.6 Entry of correctly spelled information using standardized language	• Application of learning from previous modules • Positioning of dimensions indicating movement and size • Ordering of parts by importance: - manufactured parts - standard parts • Identification of parts in drawing using: - numerical symbols - alphabetical designation - position of part numbers • Location of parts list • Content of parts list: - stock number - quantity - description - manufacturer's name and code - material - remarks • Location and content of title block
7. Check the quality of the completed drawing.	7.1 Observance of correct procedure for checking and approving a drawing 7.2 Conformity of drawings with initial data 7.3 Clear and tactful communication of comments to other team members 7.4 Positive attitude concerning comments made	• Application of relevant learning from Module 6, *Producing detail drawings of mechanical components*
8. File and print the documents.	8.1 Appropriate document management 8.2 Appropriate choice of filing method 8.3 Observance of printing procedure	• Application of relevant learning from Module 6, *Producing detail drawings of mechanical components*

MODULE 22: DRAWING THE HOUSING OF A MACHINE		CODE: 872 507 105 HOURS
Expected Behaviour	**Conditions for Performance Evaluation**	**Suggested Approach**
Draw the housing of a machine.	• Work performed alone or in a team • Related to the housing of industrial machines • Related to a project including assembly drawings and detail drawings of a housing • Given sketches and design drawings • Using a computerized work station • Using computer-aided drawing software • Using an electronic spreadsheet for the parts list • Using the standards defined by the manufacturer of the machine • Using relevant technical documentation	• The housing is the steel structure that supports a machine in a factory. It is assembled using bolts and welds. • Pay particular attention to the representation of welded joints. • Base the work on the standards defined by machine manufacturers rather than on the standards governing steel structures for buildings. • Suggested strategy: - first, show students how to recognize and draw welding symbols; a practical approach is to ask students to change moulded or forged parts in a drawing to welded parts; - next, introduce students gradually to the drawing of structures by asking them to reproduce machine housings illustrated in volumes of drawings; - last, have students draw simple housing made up of structural steel elements. One housing could, for example, be designed to hold a motor connected to a gearbox by a coupling or belt drive. The dimensions and annotations for housings should be taken from manufacturers' catalogues and the structural elements should be selected from reference volumes. • During the module, emphasize: - mastery of orthographic projection techniques - observance of conventions for the use of symbols • Clear, accurate lines and lettering

Specifications	Performance Criteria	Suggested Related Content
1. Organize the work.	1.1 Correct interpretation of sketches and design drawings 1.2 Accurate assessment of the machine to be provided with a housing: - construction features - assembly of parts - operation 1.3 Accurate transposition of data in sketch form 1.4 Appropriate preparation of work station	• Organic and functional study of the machine shown in the drawing or design sketch • Transposition of data as a preliminary drawing • Study of the positioning of the machine elements in the housing • Scale drawing of reference lines for the machine • Use of reference documents such as catalogues, tables and electronic libraries • Representation of siting
2. Draw structural elements.	2.1 Appropriate choice of structural sections in catalogues to meet the needs of the project and the manufacturer 2.2 Appropriate choice of views 2.3 Appropriate changes to elements imported from an electronic library 2.4 Correct arrangement of structural elements 2.5 Correct use of symbols 2.6 Observance of scale 2.7 Conformity of elements in drawing with characteristics of catalogue 2.8 Clear, meaningful representation of housing in three dimensions	• Recognition of structural sections on the basis of - shapes - symbols - codes • Recognition, on the basis of shape and function, of: anchors, girders, beams, base plates, brackets, columns, braces, cross members • Drawing of parts straight and reversed • Criteria to be taken into account in selecting views • Criteria to be taken into account in selecting structural elements • Standards to observe in positioning and cutting elements • Symbols for structural elements and scale of drawing • Decomposition of a structure into commercially-available elements • Recomposition of elements specifying types of welded joints: butt, corner, T, lap and edge

Specifications	Performance Criteria	Suggested Related Content
3. Represent fasteners and anchor points.	3.1 Correct determination of location and type of fasteners and anchor points 3.2 Appropriate choice of symbols from a drawing file library 3.3 Observance of standard representations	• Criteria to take into account in selecting types of joints and location on drawing • Representation of types of joints: - bolted joints - welded joints (butt, corner, T, lap and edge)
4. Represent welded joints.	4.1 Correct positioning and correct use of welding symbols 4.2 Observance of standards of representation	• Welded joints (butt, corner, T, lap and edge) • Description of processes and characteristics: - oxyacetylene welding - arc welding - brazing - resistance welding - friction welding • Interpretation of: - reference and identification lines - arrowheads - basic welding symbols - dimensions or information relating to preparation or welding - additional symbols - finish symbols - alignment of parts
5. Enter dimensions and additional information.	5.1 Accuracy of calculations, including calculations concerning welding 5.2 Accuracy of dimensions and correct placement 5.3 Correct placement of parts list 5.4 Parts list correctly drafted using spreadsheet software and imported into the drawing 5.5 Accurate and exhaustive information in parts list and annotations 5.6 Observance of drawing standards and conventions	• Calculation of the dimensions determining the location of fasteners and welds • Calculation of total length of welding rods • Use of metric and imperial systems of measurement • Observance of dimensioning standards • Representation of welding symbols • Observance of standards for annotations concerning the drawing as a whole • Drafting of parts list: - position and outline - description of table content

Specifications	Performance Criteria	Suggested Related Content
		- identification of elements • Use of spreadsheet software
	5.7 Entry of correctly spelled information	
6. Calculate and enter the weight and floor area of the housing in the drawing.	6.1 Use of appropriate method of calculation 6.2 Accuracy of information and correct placement in drawing	• Application of mathematical notions to calculate the weight of each elements and determine total mass
7. Check the drawing.	7.1 Observance of procedure for checking and approving completed drawing 7.2 Conformity of drawing with initial data and standards defined by machine manufacturer	• Application of relevant learning from Module 6, *Producing detail drawings of mechanical components*
8. File the drawing	8.1 Appropriate document filing 8.2 Appropriate choice of filing method	• Application of relevant learning from Module 6, *Producing detail drawings of mechanical components*

MODULE 23: ADAPTING TO THE NEW TYPES OF WORK ORGANIZATION CODE: 872 153 45 HOURS		
Expected Behaviour	**Conditions for Performance Evaluation**	**Suggested Approach**
Adapt to the new types of work organization.	• Working in a team • Given complete information on the operation of a manufacturing company • Using relevant documentation • In an atmosphere of respect and openness	

Specifications	Performance Criteria	Suggested Related Content
1. Recognize the production management approaches of the company and their effects on the type of work organization.	1.1 Recognition of the company's management philosophy, particularly Taylorism and added value 1.2 Proper description of preferred type of structural organization: - hierarchical organization - semi-autonomous teams - autonomous teams 1.3 Recognition of the company's production process 1.4 Appreciation of the effects of management approaches on production and on the evolution of tasks in the company	
2. Recognize the means used to promote the continual improvement of productivity.	2.1 Accurate differentiation among the instruments or techniques used in the company 2.2 Relevant associations between the means used and the company's ability to meet the requirements of the new economy, such as: - improvement of the time required to respond to market needs - economies of scale - elimination of waste 2.3 Recognition of the contribution of personnel to the improvement of productivity	

Specifications	Performance Criteria	Suggested Related Content
3. Communicate verbally with colleagues.	3.1 Choice of types of questions required to obtain relevant information 3.2 Proper reformulation of areas of agreement and disagreement in a discussion 3.3 Proper reformulation and reflection of message 3.4 Constructive and accurate feedback to: - encourage improvement in behaviour - recognize and encourage the contribution of colleagues 3.5 Relevant and persuasive expression of their point of view 3.6 Understanding of controversial comments 3.7 Use of an effective approach to deal with emotional behaviour	• Communication process • Obstacles to communication • Role of perception and defence mechanisms • Facilitating attitudes • Types of questions • Reformulation • Reflection • Summary of discussions • Personal feedback based on experience • Acceptance of emotional behaviour • Arguments supporting an opinion
4. Solve problems related to work organization.	4.1 Choice of tools and techniques in accordance with the complexity of the problem to be solved 4.2 Clear description of the problem 4.3 Determination of the causes and consequences of the problem 4.4 Choice of best solution in accordance with established criteria 4.5 Realistic plan of action 4.6 Follow-up mechanisms clearly defined and scheduled	• Advantages of using a problem-solving process • Simple process • Modern tools and techniques

Specifications	Performance Criteria	Suggested Related Content
5. Work in a multidisciplinary team.	5.1 Determination of the goals of the team and the results to be attained in accordance with the company's mission and values 5.2 Consensus on team rules 5.3 Determination of the responsibilities of each team member 5.4 Proper planning of work 5.5 Consensus decision making 5.6 Recognition of style of participation of team members 5.7 Description of favourable and unfavourable factors for each stage of the work	• Basis of an effective work team • Cooperation as opposed to competition • Roles within the team • Team rules • Styles of participation • Planning stages • Consensus decision-making process • Stages in the growth of a work team

MODULE 24: DESIGNING A SIMPLE TECHNICAL OBJECT — CODE: 872 517 — 105 HOURS

Expected Outcome	Instructional Guidelines	Suggested Approach
Design a simple technical object. *Specifications:* Understand the design process and the prerequisites for applying the process. Find a solution to a given need and demonstrate its feasibility. Represent various aspects of the solution. Become aware of personal development in terms of knowledge, skills and attitudes in connection with the design of a technical object.	• Each project should be completed by a small team (three of four students). • The project should be chosen by the team and submitted to the instructor. • Projects may be suggested by companies. • The instructor should describe various situations requiring technical solutions rather than "design" solutions, offering an appropriate degree of difficulty. • Provide sources of information for exploration and research. • Create a climate conducive to creativity and the free expression of ideas. • Encourage all students to express their point of view during discussions. • Support and guide students in their work and encourage perseverance. • Encourage students to consult each other. • Give instructions on how the work is to be presented. • Help students benefit from the module by providing them with a tool, such as a list of questions, to assist them in understanding and assessing their experience and the learning they have acquired.	This module will allow students: • to understand the stages in the design process prior to beginning work; • to participate actively when required to work with a research and development team within a company; • to broaden their view of professional career possibilities; • to integrate all the notions acquired during the program. *For Phase 1* • Prepare students to begin Phase 1 by explaining: - how to analyze a technical text; - how to apply research techniques; - how to order notes. • Suggest projects and problems that students will be able to complete easily. • Encourage student exploration and research by providing sources of information. *For Phase 2* • Support the teams throughout the design process. • Students will have to deal with uncertainty and ambiguity during the module, and the instructor should provide them with guidance without revealing the answers to their problems. The instructor should encourage students to persevere and, during the research phase, should apply various techniques to encourage creativity.

Expected Outcome	Instructional Guidelines	Suggested Approach
		For Phase 3 • The final project may be presented to leaders from business and industry, the group, or the instructor alone. • A presentation for leaders from business and industry may lead to job opportunities. • The last phase is conducive to a discussion period during which the students should assess their own work and the work of the other students. This activity will allow them to learn how to offer and receive constructive criticism. The last phase focuses on skills and attitudes in great demand in the workplace. • The instructor should stimulate students and help "trigger" ideas, ensuring that all students are able to express their ideas freely and explore all aspects of their ideas. This module allows students to demonstrate their ability to collaborate with others and remain open-minded, an attitude in great demand in the workplace. The activities in this module will create situations that encourage students to consult each other, a situation the instructor should support, while remaining attentive to possible communication problems and intervening where necessary.

Learning context	Participation Criteria	Suggested Related Content
PHASE 1: **Information on the design process** • Gathering information on the nature and steps in the design process for a technical object. • Gathering information on the knowledge, skills and attitudes required to design a technical object. • Assessing personal knowledge and skills and establishing a link with the knowledge and skills required to complete the stages of the design process. • Discussing fears concerning certain stages in the design process. • Discussing the need for an industrial drafter to acquire competency in designing.	- Consult available sources of information. - Gather and organize data. - Make a list of person knowledge, skills and attitudes and explain how they will help to complete the stages of the design process. - Formulate fears clearly. - Explain how the learning acquired in this module is useful for an industrial draftsperson.	• Collection of information on the stages in the design process: - identification of the problem - concepts and ideas - compromise solution (s) - models or prototypes - sketches - other • Analysis of a technical text: main ideas, secondary ideas and links between ideas • Description of the main stages in a methodical search for information: - definition of stages - definition of the subject - determination of the information needed - determination of sources of information - consultation of sources of information - gathering of data - organization and assessment of data • Determination of a system to order and retrieve notes: - data classification - subject definition - ordering systems (files, folders, ring binders) - retrieval system (colours, page numbering) • Search in a range of information sources • Consultation of persons with design experience (instructors, drafters, engineers, etc.) • Differentiation between the main types of design, empirical and scientific • Differentiation between the design and technical aspects of an object • Feasibility: complete the process required to study the design of an object

Learning context	Participation Criteria	Suggested Related Content
		• Application of creativity techniques: - brainstorming - idea crunching - biassociation and and combinatorial techniques - analogy • Goals and principles of diagrams • Diagramming techniques to study principles, construction and symbolization • Creation of a new object or alteration of an existing object to meet a functional need • Comparison of possible solutions with similar objects, similarities and differences, assessment of solution feasibility, selection of the best solution. • Functional study • Study of production methods • Facility of use and maintenance, durability • Appropriate use of resources inside and outside school • Use of a work schedule • Observance of deadlines for each part of project • Equitable allocation of tasks according to team member qualifications

Learning context	Participation Criteria	Suggested Related Content
PHASE 2: **Application of design process** • Analyzing the various aspects of a need, looking for related information or data sources, imagining products to meet the need, representing ideas in notes and sketches. • Comparing solutions with similar objects, finding similarities and differences, assessing the feasibility of possible solutions, selecting the best solution. • Making the drawings required to represent the object using notions and techniques learned during the program.	• Work independently and methodically, making maximum use of available resources • Remain available to help others • Perform all required work • Pay attention to the material presentation of documents	• Production of the drawings required to represent the object, using notions and techniques learned during the program • Orthographic and perspective drawings, produced freehand and using a computer. Design, manufacturing and assembly drawings • Using internal resources (teaching staff, catalogues, Internet, etc.) and external resources (family, friends, companies, etc.), accurate assessment of manufacturing time and costs • 3D drawings
PHASE 3: **Assessment of the implementation of the design process** • Presenting the project and explaining the rational process behind the design. • Summarizing the design experience, stating - the difficulties encountered and the solutions applied - the knowledge, skills and attitudes acquired - the most interesting aspects of the project, suitable for future in-depth study	• Present the project, explaining clearly the rational process behind the design • Draft a clear, concise report containing information on: - the difficulties encountered and the solutions applied - the knowledge, skills and attitudes acquired - the aspects most appreciated during the implementation of the process	• Presentation of renderings • Presentation of technical drawings • Technical description and drafting of a report • Nature and structure of content • Material presentation of document • Presentation of the project and explanation of the rational process behind the design • Oral presentation of the solution proposed • Feedback on the experience: - assessment of the difficulties encountered and the learning acquired - determination of the positive aspects of the experience - presentation of personal conclusions in the report

MODULE 25: ENTERING THE WORKFORCE		CODE: 872 526 90 HOURS
Expected Outcome	**Instructional Guidelines**	**Suggested Approach**
Enter the workforce. *Specifications*: Find a practicum position. Observe and perform trade-related tasks in the workplace. Communicate with the work team. Evaluate their training with respect to their observations during the practicum.	• Provide the students with the necessary means and assistance to find a practicum position. • Maintain close ties between the school and the company. • Make sure that the trainees receive the support and supervision of a responsible person in the company. • Ensure the regular support and supervision of students and intervene only in the case of difficulties. • Make sure that the company respects the conditions required for the students to attain the objectives of the practicum. • Encourage the students to engage in discussions and express themselves. • Provide the students with an outline for the report.	

Learning Context	Participation Criteria	Suggested Related Content
PHASE 1: **Search for a Practicum Position**	- Listing in order of priority of possible practicum positions that meet their selection criteria. - Meeting with a representative of the company in order to obtain a practicum position.	
• Learning about the practicum and the related procedures.		• Objectives of the practicum • Duration • Instructional guidelines • Participation criteria
• Defining their expectations and needs with respect to the practicum.		• Personal and occupational goals and objectives • Criteria for selecting the company, such as: - size and location - type of production - structure - quality of working relations - possibility of attaining the objectives of the practicum • Criteria meeting expectations
• Finding companies likely to meet their expectations and needs.		• Various sources: - banks of companies - telephone books - employment centres - want ads - list of companies who have accepted trainees in the past and related experiences - instructor's assistance • Classification of companies by type of product or process

Learning Context	Participation Criteria	Suggested Related Content
• Obtaining a practicum position.		• Introduction by mail, telephone or visit • Agreement on practicum procedure • Presentation to employer of the list of tasks required to pass the practicum • Confirmation of practicum • Demonstration of determination, openness, a positive attitude, availability, etc.
• Ensuring that the practicum procedure is within regulations.		• Elements to be confirmed: - insurance - registration of trainee with the CSST - agreements with unions - responsibilities of parties - other • Agreements on supervision (by the company and the instructor)
PHASE 2: **Performance of Activities in the Workplace**	- Observe company rules regarding activities, work schedules and professional ethics. - Produce a practicum report on the activities performed. - Demonstration of interest throughout the activity.	
• Observing the stages in the production of a finished drawing		• Observation of drafters as they perform their tasks • Observation of the production process • Comparisons between the production of drawings and the production of the corresponding objects

Learning Context	Participation Criteria	Suggested Related Content
• Performing various trade-related tasks or participating in their performance.		• Active participation in tasks • Observance of health and safety rules • Observance of company rules and regulations: order, schedules, attendance, movements in the shop and clothing • Behaviour: attentiveness, respect, tact, discretion, concern for excellence, demonstration of interest in all new work experiences, etc.
• Communicating with members of the work team and those responsible for the practicum.		• Search for information (desire to learn) • Transmission of information • Positive, open attitude • Acceptance of advice and comments • Feedback • Verification of satisfaction of the person responsible for the practicum • Other
• Producing a report on the tasks and operations performed during the practicum.		• Content of the practicum report: - general information on the location and date of the practicum and on those responsible in the company and the school - description of tasks performed • Types of drawings produced, new types of equipment used, new tools, etc. - problems that occurred and solutions that were applied - comments on the practicum procedure - appreciation of tasks - elements different from those presented at school - other • Daily report

Learning Context	Participation Criteria	Suggested Related Content
PHASE 3: **Evaluation of the Practicum and of the Training Received**	- Participate in discussions on their experience and on the tasks and operations performed during the practicum. - Emphasize the strong and weak points of the training received.	
• Presenting a report on the tasks and operations performed in the workplace		• Oral presentation
• Assessing the relevance of their training with respect to the requirements of the workplace.		• List of aspects of the trade that correspond to the training received and those that do not • Comparison of their perception of the trade before and after the practicum - workplace - occupational practices - equipment - other
• Stating the specific and complementary training needs in technical drawing.		• Extension courses • Specialization courses • Further training

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