7

BUILDINGS AND PUBLIC WORKS

REFRIGERATION

PROGRAM OF STUDY

5575

VOCATIONAL and TECHNICAL EDUCATION

Québec

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BUILDINGS AND PUBLIC WORKS

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REFRIGERATION

PROGRAM OF STUDY 5575

The *Refrigeration* program leads to the Secondary School Vocational Diploma (SSVD) and prepares the student to practise the trade of

REFRIGERATION MECHANIC

Direction générale de la formation professionnelle et technique

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English Version

Translation	Services à la communauté anglophone Direction de la production en langue anglaise

Gouvernement du Québec
Ministère de l'Éducation, 1996 — 95-1524

ISBN : 2-550-25946-7

Legal Deposit — Bibliothèque nationale du Québec, 1996

ACKNOWLEDGMENTS

The ministère de l'Éducation wishes to thank the following people for their invaluable assistance in the development of this program:

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This program of study, *Refrigeration*, is issued in accordance with section 461 of the *Education Act* (R.S.Q., c. I-13.3).

It has been approved by the confessional committees of the Conseil supérieur de l'éducation in conformity with the provisions of paragraph (a) of section 23 of the *Act respecting the Conseil supérieur de l'éducation* (R.S.Q., c. C-60), as replaced by section 569 of the *Education Act* (1988, chapter 84).

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INTRODUCTION

The *Refrigeration* program is based on the orientations for secondary school vocational education adopted by the government in 1986. It was designed on the basis of a new 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, which are organized into teaching blocks. 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.

The program of study lists the competencies that are the minimum requirements for a Secondary School Vocational Diploma (SSVD) 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 690 hours spent on the specific competencies required to practise the trade and 1110 hours on general competencies. The program of study is divided into 33 modules, which vary in length from 15 to 120 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. Modules are divided into four blocks of 450 hours.

This document contains two parts. Part I is of general interest and provides an overview of the training plan. It includes a synoptic table of basic information about the modules, a description of the program training goals, the competencies to be developed and the general objectives, and 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.

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

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 socio-affective behaviours, cognitive skills or psycho-sensori-motor skills that enable a person to correctly perform a role, function, 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.

Module of a Program

A component part of a program of study comprising a first-level operational objective and the related second-level operational objectives.

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: 33
Duration in hours: 1800
Credits: 120

Refrigeration
CODE: 5575

CODE		TITLE OF THE MODULE	HOURS	CREDITS*
800 012	1.	The Trade and the Training Process	30	2
800 024	2.	Refrigeration Cycle Theory	60	4
800 036	3.	Maintenance Equipment and Mechanics	90	6
800 042	4.	Oxyacetylene Cutting, Welding and Brazing	30	2
800 053	5.	Recovering Refrigerants	45	3
800 063	6.	Metering Devices	45	3
800 071	7.	Condensers and Evaporators	15	1
800 104	8.	General Electricity	60	4
800 095	9.	Basic Refrigerating Circuits	75	5
800 082	10.	Reciprocating Compressors	30	2
800 112	11.	Diagrams and Sketches	30	2
800 128	12.	Motor Circuits and Electrical Control Assemblies	120	8
800 143	13.	Piping for Refrigeration Systems	45	3
800 158	14.	Walk-in Refrigerators	120	8
800 232	15.	Heat Exchangers	30	2
800 243	16.	Electronic Control Circuits	45	3
755 002	17.	Health and Safety on Construction Sites	30	2
800 134	18.	Fluid System Regulators and Accessories	60	4
800 164	19.	Refrigerated Display Cases	60	4
800 226	20.	Ventilation and Air Conditioning Processes	90	6
800 264	21.	Maintaining and Troubleshooting Self-contained Air Conditioning Units	60	4
800 277	22.	Installing Split-system Heat Pumps	105	7
800 365	23.	Maintaining and Troubleshooting Heat Pumps	75	5
800 252	24.	Plans and Specifications	30	2
800 322	25.	Centrifugal Pumps	30	2
800 331	26.	Humidifiers	15	1
800 343	27.	Load Calculations	45	3
800 312	28.	Compressors	30	2
800 356	29.	Controllers and Control Software	90	6
800 373	30.	Chiller Maintenance	45	3
800 388	31.	Central Air Conditioning Systems	120	8
800 292	32.	Job Search Techniques	30	2
755 001	33.	Construction Organizations	15	1

* 15 hours = 1 credit
Modules are divided into blocks of 450 hours.
This program leads to an SSVD in Refrigeration.

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2. PROGRAM TRAINING GOALS

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

To develop effectiveness in the practice of a trade.

- To prepare students to perform trade-related tasks and activities correctly and at a level of performance acceptable for entering the job market.

- To prepare students to perform satisfactorily on the job by fostering:
  - mastery of basic work techniques;
  - knowledge of the scientific principles underlying the design of refrigeration and air conditioning systems and their mode of operation;
  - the development of skills needed to analyze the operating condition of a system;
  - the development of skills needed to make decisions and analyze problems related to the installation, maintenance and troubleshooting of air conditioning and ventilation systems;
  - the development of skills needed to organize and plan their work;
  - the development of the ability to communicate effectively on the job;
  - a constant concern for occupational health and safety;
  - the development of the confidence needed to handle system components safely;
  - the development of professional ethics and a concern for good workmanship and honesty;
  - attentiveness to the criteria for installing, maintaining and troubleshooting refrigeration and air conditioning systems.

To ensure that students are prepared to enter the work force.

- To familiarize students with the trade, e.g. types of systems, companies, working conditions, job prospects.

- To make students aware of the demands of the trade from the outset of the training program.

- To help students develop work attitudes that will enable them to deal with the constraints of the trade, e.g. irregular working hours, emergencies, flexibility.

- To familiarize students with the various subsidized employment programs.

- To familiarize students with the rights and responsibilities of workers by providing them with information on the Labour Code, employer associations, union associations, the CSST, and so on.

- To make students aware of business opportunities and to familiarize them with the procedures for starting a business.

- To familiarize students with the construction industry.

To foster the development of professional knowledge and skills.

- To foster the independence needed to practise the trade by encouraging the students to assume responsibilities and make responsible decisions.
- To foster good work habits by encouraging the students to research information, plan their work, prepare order forms, determine procedures for checking the systems and select problem-solving procedures.
- To help students develop their creativity by encouraging them to select one possibility among several and find solutions to problems.
- To help students understand the principles underlying the techniques used in refrigeration and air conditioning by encouraging them to relate the principles to the techniques and technologies used, and to apply theory to practice and vice versa.
- To help students develop a sense of initiative and a spirit of entrepreneurship.

To ensure job mobility within the trade.

- To provide students with sound, all-around training.
- To teach effective job search and job creation skills.
- To foster a positive attitude toward technological developments and new situations.
- To foster an open-minded view of the trade and related trades.
- To provide students with general knowledge of the operation and interrelationship of the various mechanical systems in buildings.

3. COMPETENCIES

The competencies to be developed in the *Refrigeration* program 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 (○) indicates a correlation between a general and a specific competency.

The symbols (▲) and (●) 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

REFRIGERATION

SPECIFIC COMPETENCIES (directly related to the practice of the specific occupation)		FIRST-LEVEL OPERATIONAL OBJECTIVES	DURATION (IN HOURS)	WORK PROCESS (major steps)										GENERAL COMPETENCIES (technology, personal development, etc.)																								TOTALS	
				Read and interpret the plans and specifications of the system	Visit the company and gather information	Plan the work and organize the work site	Install the components of the system	Connect the components of the system	Check the system before start-up	Start up and adjust the system	Carry out preventive maintenance procedures on the system	Solve problems related to rebuilding, modifications or repairs	Write a report of work done	Explain the vapour-compression cycle	Perform basic mechanical maintenance tasks	Perform oxyacetylene-cutting, welding and brazing operations	Perform tasks related to the reduction and recovery of chlorofluorocarbon (CFC) emissions	Install and adjust metering devices	Identify the characteristics of the construction, operation and use of evaporators and condensers	Apply the basic electrical principles and techniques	Ensure that a reciprocating compressor is functioning correctly	Draw diagrams of components and circuits	Install a motor circuit and its electrical control assembly, and ensure that they are functioning correctly	Install the piping for a refrigeration or air conditioning system	Identify the characteristics of the construction, operation and use of heat exchangers	Check the operation of an electronic control circuit	Apply concepts related to health and safety on construction sites	Ensure that the fluid system regulators and accessories are functioning correctly	Analyze various ventilation and air conditioning processes	Read and interpret plans and specifications	Describe and check the operation of centrifugal pumps	Identify the characteristics and use of humidifiers	Carry out an energy analysis of a refrigeration system	Describe the techniques for installing compressors and check their operation	Use preventive maintenance and master control schemes	Apply job search techniques	Learn about the organizations in the construction industry	NUMBER OF OBJECTIVES	DURATION (IN HOURS)
	MODULES													2	3	4	5	6	7	8	10	11	12	13	15	16	17	18	20	24	25	26	27	28	29	32	33		
	FIRST-LEVEL OPERATIONAL OBJECTIVES	T												B	B	B	B	B	B	B	B	B	B	B	B	B	S	B	B	B	B	B	B	B	S	24	
	DURATION (IN HOURS)		h											60	90	30	45	45	15	60	30	30	120	45	30	45	30	60	90	30	30	15	45	30	90	30	15		1110
1	Determine their suitability for the trade and the training process	S	30	△	△	△	△	△	△	△	△	△	△														○										
9	Assemble a basic refrigerating circuit	B	75	▲		▲	▲	▲	▲	▲			▲	●	●	○	○	●	○	○	○	○	○	○	○								○					
14	Perform tasks related to the installation of a walk-in refrigerator	B	120	△	▲	▲	▲	▲	▲	▲	△	△	▲	●	●	●	○	●	○	●	○	●	●	●	○	○	○	○	○	○	○		○	○	○	○		
19	Ensure that a refrigerated display case is functioning correctly	B	60	▲	△	▲	△		▲	▲	△	▲	▲	●	●	○	○	○	●	●	●	●	●	●	○	○	○	○	○	○			○	○				
21	Ensure that a self-contained air conditioning unit is functioning correctly	B	60	▲	△		△		▲	▲	▲	▲	▲	○	●	○	○	○	●	●	○	○	●	○	○	○	●	○	●	○		○	○	○	○			
22	Perform tasks related to the installation of a unitary or add-on split-system heat pump	B	105	▲	△	▲	▲	▲	▲	▲	▲		▲	○	●	○	○	○	●	●	○	○	●	●	●	○	●		●	○	○	○	○	○	○			
23	Ensure that a heat pump is functioning correctly	B	75	▲	△	▲	▲				▲	▲	▲	●	○	○	○	○	○	○	○	○	●	○	●	●	●	●	●	○	○	○	○	○	○			
30	Ensure that a chiller is functioning correctly	B	45	▲	△	▲	▲				▲	▲	▲	○	○	○	○	○	●	○	○	○	●	○	●	○	●	●	○	●	●		○	●	○			
31	Ensure that a central air conditioning system is functioning correctly	B	120	▲	▲	△	△		▲	▲	▲	▲	▲	○	○	○	●	○	●	○	○	○	●	○	●	●	●	●	●	●	●	●	●	●	●			
NUMBER OF OBJECTIVES		9																																		33	
DURATION (IN HOURS)			690																																		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 *Refrigeration* program are presented below, along with the major statement of each corresponding first-level operational objective.

To develop in the students the competencies required to perform tasks related to the trade of refrigeration mechanic.

- Explain the vapour-compression cycle.
- Draw diagrams of components and circuits.
- Read and interpret plans and specifications.
- Perform basic mechanical maintenance tasks.
- Perform oxyacetylene-cutting, welding and brazing operations.
- Perform tasks related to the reduction and recovery of chlorofluorocarbon (CFC) emissions.
- Carry out an energy analysis of a refrigeration system.
- Analyze various ventilation and air conditioning processes.

To develop in the students the competencies required to carry out electrical tasks on refrigeration and air conditioning systems.

- Apply the basic electrical principles and techniques.
- Install a motor circuit and its electrical control assembly, and ensure that they function correctly.
- Check the operation of an electronic control circuit.

To develop in the students the competencies required to carry out mechanical tasks on refrigeration and air conditioning systems.

- Install the piping for a refrigeration or air conditioning system.
- Install and adjust metering devices.
- Ensure that the fluid system regulators and accessories are functioning correctly.
- Identify the characteristics of the construction, operation and use of evaporators and condensers.
- Ensure that a reciprocating compressor is functioning correctly.
- Describe the techniques for installing compressors and check their operation.
- Describe and check the operation of centrifugal pumps.
- Identify the characteristics of the construction, operation and use of heat exchangers.
- Identify the characteristics and use of humidifiers.

To develop in the students the competencies required to integrate harmoniously into the training program and the labour market.

- Apply concepts related to health and safety on construction sites.
- Determine their suitability for the trade and the training process.
- Apply job search techniques.
- Learn about the organizations in the construction industry.

To develop in the students the competencies required to apply various procedures and to process information related to the trade of refrigeration mechanic.

- Use preventive maintenance and master control software.

To develop in the students the competencies required to install, maintain and troubleshoot refrigeration and air conditioning systems.

- Assemble a basic refrigerating circuit.
- Perform tasks related to the installation of a walk-in refrigerator.
- Ensure that a refrigerated display case is functioning correctly.
- Ensure that a self-contained air conditioning unit is functioning correctly.
- Perform tasks related to the installation of a unitary or add-on split-system heat pump.
- Ensure that a heat pump is functioning correctly.
- Ensure that a chiller is functioning correctly.
- Ensure that a central air conditioning system is functioning correctly.

5. FIRST- AND SECOND-LEVEL OPERATIONAL OBJECTIVES

5.1 DEFINITION

A first-level objective is defined for each competency to be developed. 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.

First-level 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.

Second-level operational objectives are intermediate teaching/learning targets deemed prerequisite for attaining first-level objectives. They are grouped according to the specifications (see 5.2 A) or the phases (see 5.2 B) of the first-level objective.

The division of operational objectives into first- and second-level objectives is based on a clear distinction between the levels of learning:

- learning involving prerequisite knowledge

- learning involving competencies

Second-level operational objectives indicate prerequisite knowledge. They prepare the students to learn what is necessary to attain the first-level operational objectives, which collectively lead to the development of a competency. The objectives should always be adapted to meet the particular needs of the individual students or groups of students.

First-level operational objectives cover the learning that the students need to develop a competency:

- The specifications or the phases of the objective determine or guide specific learning, thereby allowing the competency to be developed step by step.

- The objective as a whole (i.e. the six components and in particular the last phase of a situational objective) determines or guides the overall learning and the integration and synthesis of this learning, allowing the competency to be developed fully.

To attain the objectives, the following learning activities may be prepared:

- specific learning activities for second-level objectives
- specific learning activities for the specifications or phases of first-level objectives
- general learning activities for first-level objectives

5.2 HOW TO READ FIRST-LEVEL OPERATIONAL OBJECTIVES

A. How to Read a Behavioural Objective

Behavioural objectives consist of six components. The first three provide an overview of the objective:

1. 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.
2. The **conditions for performance evaluation** define what is necessary or permissible to the students during evaluation designed to verify whether or not the students have attained the objective. This means that the conditions for evaluation are the same wherever and whenever the program is taught.
3. The **general performance criteria** define the requirements by which to judge whether or not the results obtained are generally satisfactory.

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

4. The **specifications of the expected behaviour** describe the essential elements of the competency in terms of specific behaviours.
5. 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.
6. 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:

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

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

3. 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

4. The **instructional guidelines** provide suggested ways and means of teaching the course to ensure that learning takes place and that the same conditions apply wherever and whenever the course is taught. These guidelines may include general principles or specific procedures.

5. The **participation criteria** describe the requirements the students must fulfil, which are usually related to each phase of the learning context. 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.

6. **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.

PART II

MODULE 1: THE TRADE AND THE TRAINING PROCESS

CODE: 800 012 **Duration: 30 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

EXPECTED OUTCOME

By participating in the required activities of the learning context according to the indicated criteria, the students will be able to
determine their suitability for the trade and the training process.

SPECIFICATIONS

At the end of this module, the students will:

- Be familiar with:
  - the trade
  - the targeted learning objectives and the proposed learning process
  - the various types of companies in the industry
- Confirm their career choice.

LEARNING CONTEXT

PHASE 1: **Information**

- Learning about various aspects of the socioeconomic situation in the field and the relationships among the various jobs.

- Learning about the nature and requirements of the job (e.g. tasks, physical and mental aptitudes, skills, education).

- Learning about the job market in refrigeration and air conditioning (e.g. types of companies, production methods, working conditions).

- Learning about the training goals, program content, the learning process, evaluation methods and the certification of studies.

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

LEARNING CONTEXT

PHASE 1: **Information**

- Learning about foreseeable technological changes and the resulting need to continually upgrade skills.

PHASE 2: **Participation**

- Discussing the trade in general (e.g. requirements, career, professional conduct).
- Visiting construction sites or companies and obtaining information on their organizational structure, employer expectations, and so on.
- Discussing the accuracy of their original perceptions of the trade after these visits.
- Visiting the refrigeration and air conditioning workshop in the school and discussing how it is equipped and organized (e.g. types of systems, facilities, laboratories, learning modules, health and safety measures).
- Discussing the relationship between the main elements of the training program and the various aspects of the trade itself.

PHASE 3: **Self-evaluation**

- Evaluating their career choice on the basis of the information they have gathered, their observations of various aspects of the trade and their personal preferences and goals.

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

INSTRUCTIONAL GUIDELINES

The teacher should:

- Make suitable reference materials available to the students (e.g. programs of study, job situation analysis reports).
- Arrange for students to meet with trade specialists who can provide a general picture of the trade.
- Present the program content and the requirements of the trade in a clear and realistic manner.
- Provide guidance and supervision for research, field trips and discussions.
- Ensure that students have access to the school facilities, workshops and laboratories.
- Provide a list of companies that employ former students.
- Ensure that counselling is available to help any undecided students with their career choice.

PARTICIPATION CRITERIA

PHASE 1:

- Examine available materials and gather information on most of the topics to be covered.
- In a group discussion, express their views on the trade, relating them to the information they have gathered.

PHASE 2:

- Express their opinions on essential aspects of the trade.
- Listen carefully to explanations.
- In a group discussion, express their views on the training program.

PHASE 3:

- Write a report in which they:
  - briefly describe their preferences, interests and aptitudes;
  - explain how they arrived at their career choice.
- Discuss their career choice with a staff member.

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

FIELD OF APPLICATION

- Refrigeration and air conditioning

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before undertaking any of the activities:

1. Become aware of the objective and the proposed learning process.
2. Be willing to share their views on the trade with the other members of the group.

Before undertaking the activities of Phase 1:

3. Describe the job market in the field of refrigeration and air conditioning.
4. List the tasks performed by a refrigeration mechanic, taking into account their relative importance and the frequency with which they are performed in different types of companies.
5. Discuss working conditions.
6. List the cognitive and motor skills essential to the practice of the trade.
7. Be familiar with the general behaviours essential to the practice of the trade.
8. Give a brief description of the main types of refrigeration and air conditioning systems.

Before undertaking the activities of Phase 2:

9. Observe occupational health and safety precautions.
10. Observe the working conditions at the companies visited.
11. Observe any particular physical requirements for refrigeration and air conditioning work, during visits to companies.
12. Give a general description of the program of study in refrigeration and air conditioning.
13. Give a general description of the training program.
14. Obtain information on the evaluation of experiential and scholastic learning.
15. Discuss the qualifications needed to enter the job market.
16. Demonstrate the importance of sound training adapted to the needs of the job market.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before undertaking the activities of Phase 3:

17. State their personal preferences, aptitudes and interests in relation to the trade.
18. State the aspects of the trade that are of special interest to them.

MODULE 2: REFRIGERATION CYCLE THEORY

CODE: 800 024 **Duration: 60 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
explain the vapour-compression cycle
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Given hypothetical situations
- Following the teacher's instructions
- Using technical documentation authorized by the teacher

GENERAL PERFORMANCE CRITERIA

- Accurate description of the refrigeration cycle
- Clear and accurate explanation of the various physical processes that characterize the refrigeration cycle
- Accurate location of each process within the refrigeration cycle
- Use of appropriate terminology

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Draw the diagram of a vapour-compression cycle.	- Knowledge of basic components - Accurate representation and identification of the lines connecting the components - Accurate indication of direction of flow - Clear diagram
B. Explain heat transfer in the refrigeration cycle, referring to the applicable laws.	- Accurate statement of laws concerning: • heat transfer • the effects and measurement of heat - Accurate definition of concepts - Satisfactory explanation of the heat transfer between the surrounding medium and the refrigerant in the coils (evaporators and condensers)
C. Explain the four stages of the refrigeration cycle, referring to gas and thermodynamics laws.	- Accurate statement of the main laws: • perfect gas laws: Charles' Law, Boyle's Law • effect of pressure on the boiling point of a refrigerant • latent heat of vaporization and condensation • cooling effect - Accurate definition of concepts - Satisfactory explanation of the changes occurring at each stage - Accurate location of each stage within the refrigeration cycle

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
D. Describe the state of the refrigerant at the inlet and outlet of each component.	- Accurate description of states: • liquid or vapour • high or low pressure • saturated, superheated or subcooled
E. Define the superheating and subcooling of a refrigerant.	- Accurate definitions - Accurate location of the two phenomena within the refrigeration cycle

FIELD OF APPLICATION

- Refrigeration and air conditioning
- All tasks performed by refrigeration mechanics

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to draw the diagram of a vapour-compression cycle (A):

1. Describe the main components of a simple refrigeration system.
2. Indicate, on the diagram of a refrigeration cycle, the state of the refrigerant at the inlet and outlet of each component of the refrigeration system.

Before learning how to explain heat transfer in the refrigeration cycle, referring to the applicable laws (B):

3. Explain the physical phenomena related to heat.
4. Define the concept of temperature and interpret temperature scales.
5. Convert temperature readings from one temperature scale to another.
6. Define the concept of energy.
7. Do basic heat transfer calculations.

Before learning how to explain the four stages of the refrigeration cycle, referring to gas and thermodynamics laws (C):

8. Explain the expansion of the refrigerant within the refrigeration cycle.
9. Explain evaporation within the refrigeration cycle.
10. Explain the compression of the refrigerant within the refrigeration cycle.
11. Explain the condensation of the refrigerant within the refrigeration cycle.

Before learning how to describe the state of the refrigerant at the inlet and outlet of each component (D) and to define the superheating and subcooling of a refrigerant (E):

12. Define the pressure of a gas in a vacuum.
13. Define the perfect gas law.
14. Describe the effects of pressure on a refrigerant.
15. Use various pressure-measuring instruments.

MODULE 3: MAINTENANCE EQUIPMENT AND MECHANICS

CODE: 800 036 **Duration: 90 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
perform basic mechanical maintenance tasks
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Using specifications describing the project
- Using the necessary tools and instruments
- Using all the necessary components
- Without using technical documentation

GENERAL PERFORMANCE CRITERIA

- Knowledge of tools, measuring instruments and machine parts
- Accurate description of the operating and maintenance procedures for tools and instruments
- Mastery of techniques for assembling and disassembling machine parts
- Mastery of basic techniques for working on piping
- Neat work and work areas
- Observance of health and safety rules

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Describe the operating and maintenance procedures for the main hand, power and cutting tools.	- Knowledge of each tool - Appropriate description of operating and maintenance procedures for the tools - Appropriate description of relevant safety measures
B. Describe the operating and maintenance procedures for the main measuring instruments.	- Appropriate description of methods for handling and reading the instruments - Appropriate description of precautions to be taken when handling the instruments - Accurate description of maintenance procedures
C. Perform basic tasks on metal parts.	- Mastery of the following techniques: • drilling • filing • bending • cutting • scoring • threading
D. Disassemble a machine.	- Knowledge of parts and their function: • fasteners • bearings • gaskets - Appropriate choice of tools and measuring instruments - Mastery of disassembly techniques - No damage to parts

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
E. Assemble a machine.	- Knowledge of parts and their function - Appropriate choice of tools and measuring instruments - Logical assembly sequence - Quality assembly: • neat assembly • machine in good working condition • assembly in accordance with specifications • machine completely leakproof
F. Assemble copper piping.	- Mastery of the following techniques: • cutting • reaming • flaring • bending • soldering • assembling • pressure testing - Safe work procedures and methods

FIELD OF APPLICATION

- Refrigeration and air conditioning
- The main types of machine parts used in these fields, basic work techniques and basic hand and power tools (e.g. pliers, screwdrivers, wrenches, tube cutters, flaring blocks, hacksaws, chisels, electric drills, grindstones, vices, measuring and scoring instruments)

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to describe the operating and maintenance procedures for the main hand, power and cutting tools (A):

1. Describe the characteristics of hammers.
2. Describe the characteristics of screwdrivers.
3. Describe the characteristics of nut and bolt wrenches.
4. Describe the characteristics of pliers.
5. Describe the characteristics of vices.
6. Describe the characteristics of power tools.
7. Describe the characteristics of cutting tools.
8. Describe the operating and maintenance procedures for hand tools.
9. Describe the operating and maintenance procedures for power tools.
10. Describe the operating and maintenance procedures for cutting tools.

Before learning how to describe the operating and maintenance procedures for the main measuring instruments (B):

11. List the measuring and scoring instruments and describe their characteristics.
12. Sharpen scoring instruments that require this type of maintenance.
13. Maintain scoring and measuring instruments.

Before learning how to perform basic tasks on metal parts (C):

14. Recognize the different materials used in the manufacture of machines and list their characteristics.
15. Recognize threaded fasteners and list their characteristics.
16. Recognize unthreaded fasteners and list their characteristics.
17. Recognize permanent assemblies and list their characteristics.

Before learning how to disassemble a machine (D):

18. Plan and explain the method of disassembling pieces of machinery.
19. Remove broken bolts or taps.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to assemble a machine (E):

20. Recognize bearings and explain the characteristics of their construction, use and maintenance.
21. Plan and explain the method of assembling various pieces of machinery.

Before learning how to assemble copper piping (F):

22. Recognize the tools required for working on copper piping and list their characteristics.
23. Determine the methods of assembling the copper piping used in refrigeration and air conditioning.
24. Describe the characteristics of pipe couplings.
25. Recognize the piping used in refrigeration and air conditioning and describe their characteristics.
26. Cut copper pipes.
27. Bend copper pipes.
28. Ream and flare copper pipes.
29. Draw copper pipes.
30. Weld the couplings and flared parts of copper piping.

MODULE 4: OXYACETYLENE CUTTING, WELDING AND BRAZING

CODE: 800 042 **Duration: 30 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must **perform oxyacetylene-cutting, welding and brazing operations** in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working in a workshop
- Following instructions
- Using the necessary tools, welding equipment and materials
- Using authorized technical documentation

GENERAL PERFORMANCE CRITERIA

- Appropriate preparation of workstation
- Mastery of oxyacetylene-cutting, welding and brazing techniques
- Quality work:
  - precise cuts
  - deburred parts
  - uniform welds
- Mastery of techniques for maintaining tools
- Observance of health and safety rules
- Respect for the work environment
- Observance of time limits

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Start up an oxyacetylene welding set-up.	- Accurate description of the parts of the set-up - Appropriate settings - Appropriate technique for cleaning welding tips - Appropriate description of safety measures
B. Make autogenous welds on mild steel using the oxyacetylene welding process.	- Appropriate choice of welding rod - Appropriate adjustment of flame - Mastery of techniques for welding joints: • butt and lap welds • inside corner joint (T) • outside corner joint - Quality welds
C. Make heterogeneous welds on ferrous and non-ferrous metals using the oxyacetylene welding process.	- Appropriate choice of welding rod and flux - Mastery of welding techniques: • clean parts • preheated parts - Quality welds
D. Perform oxyacetylene-cutting operations on ferrous metal.	- Appropriate choice of cutting tip - Appropriate pressure adjustment - Correct procedure for lighting tips and shutting down - Appropriate adjustment of flame - Correct striking techniques • edge of part • full-plate - Quality cuts

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
E. Make flat position welds on mild steel using the electric arc welding process.	- Appropriate choice of electrode according to thickness of metal - Appropriate adjustment of polarity and current - Mastery of striking and welding techniques - Accurate description of method of storing electrodes - Quality welds

FIELD OF APPLICATION

- Refrigeration and air conditioning
- Basic electric arc and oxyacetylene welding techniques on angle iron, bars and piping for refrigeration and air conditioning systems
- Basic oxyacetylene-cutting techniques

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to start up an oxyacetylene welding set-up (A):

1. Recognize, by sight, the main industrial materials used.
2. Recognize industrial materials (ferrous and non-ferrous) according to manufacturers' codes, commercial shapes, standard dimensions and observation of sparks.
3. Define the terminology related to autogenous welding, heterogenous welding and oxyacetylene cutting and describe the use of each process.
4. List the main characteristics of the gases used in oxyacetylene welding and cutting.
5. Describe the components of an oxyacetylene welding and cutting set-up, as well as the basic tools and equipment used.
6. Set up the equipment for safe oxyacetylene welding and cutting.
7. Do the preliminary adjustments and maintenance required for the safe operation of an oxyacetylene welding and cutting set-up.
8. Select the accessories required to perform oxyacetylene welding and cutting operations.

Before learning how to make autogenous welds on mild steel using the oxyacetylene welding process (B), to make heterogeneous welds on ferrous and non-ferrous metals using the oxyacetylene welding process (C) and to perform oxyacetylene-cutting operations on ferrous metals (D):

9. Shut down an oxyacetylene welding and cutting set-up safely.

Before learning how to make flat position welds on mild steel using the electric arc welding process (E):

10. Define electric arc welding.
11. Describe the types of electric arc welding machines.
12. Recognize all the components of an electric arc welding set-up.
13. Recognize the basic types of joints and welds.
14. Select electrodes for assembling parts.
15. Strike and restrike the arc.

MODULE 5: RECOVERING REFRIGERANTS

CODE: 800 053 **Duration: 45 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
perform tasks related to the reduction and recovery of chlorofluorocarbon (CFC) emissions
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Following the teacher's instructions
- Given hypothetical current situations related to the reduction of refrigerant emissions and their recovery
- Using the necessary tools and equipment (e.g. recovery device, vacuum pump, cylinder, detector)
- Using the relevant technical documentation

GENERAL PERFORMANCE CRITERIA

- Observance of regulations regarding chlorofluorocarbon emissions and recovery
- Careful handling of tools and instruments
- Observance of occupational health and safety rules
- Use of personal safety equipment (e.g. mask, goggles, gloves)
- Clean, careful work

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Perform preventive maintenance tasks on refrigeration units in order to reduce chlorofluorocarbon emissions.	- Attentive visual inspection of system - Clean system - Appropriate use of leak detectors - Complete and attentive verification of: • components in order to detect leaks • oil pressure of the system and oil level in the compressor • level of refrigerant through the sight glass
B. Recover refrigerants.	- Accurate determination of the refrigerant to be recovered: • type of refrigerant • level of contamination - Safe and appropriate use of recovering device • system shutdown • use of appropriate cylinders • accurate identification of container • proper connection of hoses between the recovering device and the refrigeration unit • observance of maximum capacity of containers - Appropriate use of tools and materials (e.g. pressure gauges, hoses, scales, acidity tester)

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
C. Handle and store refrigerants and eliminate contaminated refrigerants.	- Safe handling of cylinders of refrigerant - Cylinders stored at the appropriate locations - Observance of regulations related to the elimination of refrigerants - Observance of regulations related to the transportation of hazardous materials
D. Replace prohibited refrigerants.	- System properly cleaned - Appropriate selection and installation of replacement parts (e.g. filters, dehydrators) - Proper installation of new parts (e.g. expansion valve, sensing probe) - Accurate determination of potential leaks - Complete verification of leakproof state of system - Appropriate selection of replacement refrigerant - Appropriate identification of new refrigerant on nameplate

FIELD OF APPLICATION

- Household, commercial and industrial refrigeration, air conditioning and ventilation equipment

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to perform preventive maintenance tasks on refrigeration units in order to reduce chlorofluorocarbon emissions (A):

1. Describe the environmental consequences of the use of refrigerants containing chlorofluorocarbons.
2. Describe the main provisions of regulations related to chlorofluorocarbons.
3. Identify various refrigerants.
4. Read, interpret and calculate parameters on the basis of refrigeration nomographs and diagrams.
5. Describe the main methods of detecting refrigerant leaks.

Before learning how to recover refrigerants (B):

6. Describe the physico-chemical properties of refrigerants.
7. Be familiar with the boiling point and the latent heat of vaporization (at normal air pressure) of various refrigerants.
8. Identify the main types of recovery devices.
9. Describe the operating principle of recovery devices.

Before learning how to handle and store refrigerants and eliminate contaminated refrigerants (C):

10. Calculate, using a pressure gauge, the pressure variation experienced by refrigerants in their reservoir following variations in ambient temperature.
11. Determine the temperature of refrigerants in their reservoir on the basis of their pressure and vice-versa, using a temperature and pressure nomograph.
12. Describe the methods for regenerating contaminated refrigerants.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to replace prohibited refrigerants (D):

13. Measure the pressure of refrigerants at different locations in units in operation, using a pressure gauge.
14. Describe the particular characteristics of the use of refrigerants.
15. Describe the characteristics of the main replacement refrigerants.
16. Do a series of verifications to assess the quality of an oil sample taken from a compressor.
17. Describe the physico-chemical properties of the oils used in refrigeration.

MODULE 6: METERING DEVICES

CODE: 800 063 **Duration: 45 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
install and adjust metering devices
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working in a laboratory
- Installing a metering device on a functional refrigeration system (learning module) that is adequately charged with refrigerant
- Adjusting at least two different types of metering devices according to instructions
- Using the appropriate technical documentation
- Using the necessary tools and instruments
- Using the necessary parts

GENERAL PERFORMANCE CRITERIA

- Appropriate description of the characteristics and mode of operation of metering devices
- Appropriate choice of metering devices according to the system
- Mastery of installation techniques
- Mastery of adjustment techniques
- Mastery of techniques for using pressure gauges and thermometers
- Quality installation:
  - observance of manufacturer's specifications
  - neat work
- Appropriate adjustment of systems (precautions with regard to superheating)
- Observance of health and safety rules
- Observance of time limits

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Identify the main types of metering devices.	- Correct identification of the different metering devices - Appropriate description of the characteristics of the construction and operation of metering devices - Appropriate description of the advantages and disadvantages of each type of metering device
B. Choose a metering device.	- Appropriate description of all the operating conditions of a metering device - Appropriate use of catalogues - Appropriate selection of metering device - Logical justification of selection, based on the characteristics of the metering device
C. Position and connect the metering device and its accessories, if necessary.	- Position of device in accordance with: • manufacturer's standards regarding operation, maintenance and safety • the techniques, standards and codes related to connections - Metering device and connections completely leakproof
D. Determine the degree of superheat in the evaporator.	- Accurate determination in accordance with the application and evaporator TD
E. Adjust the thermostatic expansion valve.	- Adjustment in accordance with the determined degree of superheat

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

FIELD OF APPLICATION

- All metering devices used in ventilation and air conditioning systems

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to identify the main types of metering devices (A):

1. Identify the types of metering devices used in compression refrigeration and air conditioning.
2. Describe the characteristics of the construction and operation of metering devices.

Before learning how to choose a metering device (B):

3. Install and adjust automatic expansion valves on a learning module.
4. Install a capillary tube and verify the operation of the system (learning module).
5. Install and adjust a simple thermostatic expansion valve on a learning module.

Before learning how to position and connect the metering device and its accessories, if necessary (C):

6. Describe the methods of installing and adjusting thermostatic expansion valves with external equalizers.
7. Describe the variables to be taken into consideration when determining the location and position of a thermostatic expansion valve.
8. Indicate the techniques for installing thermostatic expansion valves.
9. Describe the construction characteristics and the mode of operation of distributors.

Before learning how to determine the degree of superheat in the evaporator (D):

10. Define superheat in the evaporator and describe its effects on the efficient operation of the system.

Before learning how to adjust the thermostatic expansion valve (E):

11. Describe the techniques for checking and adjusting metering devices.

MODULE 7: CONDENSERS AND EVAPORATORS

CODE: 800 071 **Duration: 15 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
identify the characteristics of the construction, operation and use of evaporators and condensers
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Using graphical representations
- Following instructions

GENERAL PERFORMANCE CRITERIA

- Appropriate description of the following aspects of various evaporators and condensers:
  - components of various types of evaporators and condensers
  - operating principles of various types of evaporators and condensers
  - criteria for selection and installation
  - maintenance procedures

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Identify different types of evaporators and condensers.	- Appropriate description of: • type (classification) • materials used • fluid circulation • possible applications
B. Explain the mode of operation of evaporators and condensers.	- Accurate explanations concerning: • operation in a refrigeration or air conditioning system • method of heat transfer
C. List the criteria for selecting evaporators and condensers.	- Complete list of criteria
D. Describe the factors to be considered when installing evaporators.	- Appropriate description of: • power • direction of air current • position • condensation drainage • anchoring devices • defrosting
E. Describe the factors to be considered when installing condensers.	- Appropriate description of: • ventilation • position • connections • handling • anchoring devices

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
F. Describe the maintenance procedures for condensers and evaporators.	- Appropriate description of factors necessary for the efficient operation of condensers and evaporators - Appropriate description of the following maintenance procedures, if necessary: • checking efficiency • eliminating vibrations • cleaning • treating the water • cleaning the drains

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to identify different types of evaporators and condensers (A):

1. Explain the function of an evaporator.
2. Identify the expansion processes of the refrigerant in an evaporator.
3. Identify the various air circulation processes of evaporators.
4. Identify different types of evaporators and their uses.
5. Justify the use of various materials in manufacturing evaporators.
6. Explain the function of condensers in the refrigeration cycle.
7. Describe various circulation processes of the refrigerant in condensers.
8. Identify different types of condensers.

Before learning how to explain the mode of operation of evaporators and condensers (B):

9. Explain the method of heat transfer in evaporators and condensers.

Before learning how to list the criteria for selecting evaporators and condensers (C), to describe the factors to be considered when installing evaporators (D), to describe the factors to be considered when installing condensers (E) and to describe the maintenance procedures for condensers and evaporators (F):

10. List the factors that can affect the efficiency of an evaporator or a condenser.

MODULE 8: GENERAL ELECTRICITY

CODE: 800 104 **Duration: 60 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
apply the basic electrical principles and techniques
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Using the necessary components
- Using the appropriate assembly module
- Using the necessary tools and instruments

GENERAL PERFORMANCE CRITERIA

- Accurate explanation of the basic electrical principles
- Accurate calculation of various electrical parameters
- Accurate explanation of the operating logic of an electrical circuit
- Quality electrical diagram:
  - clear lines
  - use of correct symbols
  - feasibility of circuit
- Mastery of techniques for using the measuring instruments and tools required for electrical work
- Mastery of basic techniques for assembling electrical circuits
- Quality circuit:
  - observance of *Canadian Electrical Code* and standards
  - functional circuit
  - neat work
- Observance of health and safety rules
- Observance of time limits

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Explain the production and movement of electric current.	- Accurate definition of basic concepts - Appropriate explanations - Accurate description of: • concept of electrical power • the relationship between voltage, current and resistance (Ohm's Law) - Accurate distinction between alternating and direct current
B. Solve problems related to the application of Ohm's Law and the concepts of power and energy.	- Accurate calculations
C. Describe the characteristics and use of instruments for measuring electrical parameters.	- Accurate description of the characteristics of the instruments - Accurate description of the operating principles of the instruments - Accurate identification of the electrical parameters to be measured with these instruments - Accurate description of the method of use: • choice of function, if necessary • scale selection • connection of sensors • readings

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
D. Draw the diagram of an electrical circuit.	- Schematic diagram: • logic • clarity • correct symbols - Connection diagram: • clarity • correct symbols and codes • feasibility and economical considerations
E. Install and connect the components of an electrical circuit.	- Installation in accordance with diagram - Quality connections - Neat wiring - Safe assembly in accordance with standards
F. Check the operation of an electrical circuit.	- Appropriate verification method - Proper use of measuring instruments - Functional circuit in accordance with instructions

FIELD OF APPLICATION

- Fields related to refrigeration
- Basic electrical theory and basic theory related to the creation of series-parallel circuits

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to explain the production and movement of electric current (A):

1. Describe the nature of electricity.
2. Describe the sources of electricity.
3. Define the properties of a conductor and an electric insulator.
4. Interpret the characteristics of an alternating voltage curve.
5. List the characteristics of direct and alternating voltage.
6. Describe the characteristics of the voltage and current of a sine wave.
7. Interpret the characteristics of voltage or current curves with a given phase displacement angle.
8. Define Ohm's Law.
9. Explain the principles of electromagnetism.
10. Identify the methods of generating secondary voltage in a winding.
11. Give a brief description of some applications of electromagnetism.

Before learning how to solve problems related to the application of Ohm's Law and the concepts of power and energy (B):

12. Define and analyze various circuits.
13. Identify the methods of calculating resistance in different types of circuits.
14. Determine the behaviour of voltage and current in different circuits.
15. Define the basic concepts of power and energy.

Before learning how to describe the characteristics and use of instruments for measuring electrical parameters (C):

16. Identify the instruments used to measure the main electrical parameters.
17. Identify the categories of AC voltmeters according to the type of reading provided.
18. Identify the functions of a digital-display multimeter.
19. Measure the values of an electrical circuit using a multimeter.
20. Measure the power of an electrical circuit using a simple wattmeter.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to draw the diagram of an electrical circuit (D):

21. Draw the schematic diagram of an electrical circuit on the basis of specifications.
22. Interpret an electrical circuit using a wiring diagram.

Before learning how to install and connect the components of an electrical circuit (E):

23. Interpret the ways of identifying wires.
24. Consult the *Canadian Electrical Code*.
25. Describe the techniques for joining conductors.
26. Connect wires so as to ensure continuity and adequate mechanical resistance.
27. Select connectors and compression clamps according to the type of connection to be made and various specifications.
28. Recognize the main equipment for connecting and interconnecting electrical equipment.
29. Recognize the types of connectors for connecting conductors by their nature and the method of fastening them.
30. List the main factors to be considered when installing connection equipment.
31. Determine the cable run in a building.
32. Install cable brackets on the surface of a structure.
33. Connect equipment.
34. Identify the main methods of protecting electrical circuits and equipment.
35. Recognize the approved protection devices for the automatic opening of circuits.
36. Select protection devices for the automatic opening of circuits.
37. Install or replace protection devices.

Before learning how to check the operation of an electrical circuit (F):

38. Describe the operation of an electrical circuit using a schematic diagram.

MODULE 9: BASIC REFRIGERATION SYSTEMS

CODE: 800 095 **Duration: 75 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
assemble a basic refrigeration system
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Using a laboratory assembly module
- Using a diagram produced by the student
- Using all the necessary materials
- Using all the necessary tools and instruments
- Without using technical documentation

GENERAL PERFORMANCE CRITERIA

- Mastery of techniques for assembling, checking and starting up the circuit
- Observance of health, safety and environmental rules
- Observance of time limits

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Draw the diagram of a refrigeration system.	- Clear, logical diagram - Accurate identification of components on the diagram: • four basic components • basic accessories • lines

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
B. Prepare the materials required to assemble the circuit.	- Appropriate selection of tools, instruments, equipment and materials
C. Install the components of the circuit on the assembly module.	- Solid assembly
D. Connect the components.	- Careful handling of components - Conformity with diagram - Quality connections
E. Verify the circuit before start-up.	- Complete list of operations - Conformity with work plan - Proper verification sequence
F. Start up the system.	- Mastery of technique for charging the system - Appropriate adjustment of thermostatic expansion valve and operating pressures and temperatures
G. Complete the circuit diagram.	- Indication of: • discharge and suction pressure • evaporation, condensation, discharge and superheat temperatures - Correct arrangement of information on diagram
H. Prepare a report of the work done.	- Inclusion of: • completed diagram • list of tools, instruments and materials used • list of operations carried out

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to draw the diagram of a refrigeration system (A):

1. Recognize the components of a basic circuit.

Before learning how to prepare the materials required to assemble the circuit (B) and to install the components of the circuit on the assembly module (C):

2. Describe the piping and fittings of a basic circuit.
3. Work on the copper piping of a refrigeration system.
4. Locate the basic components.

Before learning how to connect the components (D):

5. Apply the techniques related to the installation of the piping of a basic circuit.

Before learning how to verify the circuit before start-up (E):

6. Describe the methods used to detect leaks in a refrigeration system.
7. Install the pressure gauges.
8. Use the service valves on the compressor and reservoir.
9. Use the leak-detection devices.
10. Detect and explain a decrease in the test pressure of the system.
11. Explain the purpose of dehydrating and removing the air from a refrigeration system.
12. Dehydrate and drain the air from the system using a vacuum pump.
13. Drain the air from the system using the compressor.
14. Check the oil level in the compressor.
15. Add oil to the compressor.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to start up the system (F):

16. Describe the methods of charging refrigeration systems with refrigerant.
17. Charge the refrigerant (low-pressure vapour).
18. Recover the refrigerant in a cylinder.
19. Transfer the refrigerant from the cylinder to a graduated charging cylinder.
20. Charge the refrigerant (high-pressure liquid).
21. Store the refrigerant in the system reservoir.
22. Replace the system's thermostatic expansion valve with another type of metering device.

Before learning how to complete the circuit diagram (G) and to prepare a report of the work done (H):

23. Take readings of the system's operating temperatures and pressures.

MODULE 10: RECIPROCATING COMPRESSORS

CODE: 800 082 **Duration: 30 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
ensure that a reciprocating compressor is functioning correctly
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working in a workshop or laboratory
- Using an open-type or semi-hermetic reciprocating compressor
- Using all the necessary technical documentation, such as catalogues and graphic representations (exploded views)
- Using the necessary tools and instruments

GENERAL PERFORMANCE CRITERIA

- Appropriate description of the characteristics of the construction and operation of reciprocating compressors
- Mastery of work techniques: installation, removal, disassembly, assembly
- Appropriate selection of replacement parts
- Quality work:
  - compressor in good operating condition
  - clean compressor and work area
- Observance of health and safety rules
- Observance of time limits

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Describe the characteristics of the construction and operation of various reciprocating compressors.	- Accurate description of the following characteristics: • type of crankcase • capacity • main parts • function of the parts - Appropriate description of the mode of operation - Use of appropriate terminology (English and French)
B. Remove the compressor from the module.	- Mastery of techniques: • no contamination of system • no loss of refrigerant
C. Disassemble the compressor.	- Proper sequence of disassembly - Appropriate identification and arrangement of parts on the workbench - Appropriate cleaning of parts - Careful handling of parts
D. Select replacement parts.	- Observation of instructions - Mastery of techniques for checking parts - Appropriate description of the nature and probable causes of any defects - Appropriate selection of replacement parts
E. Assemble the compressor.	- Logical sequence of operations - Quality assembly: • leakproof compressor • appropriate oil level • appropriate selection of oil • appropriate bolt torque

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
F. Install the compressor on the module and check its operation.	- Logical sequence of operations - Position of service valves: • no contamination • reuse of refrigerant - Leakproofness of connections to service valves - Solid assembly - Compressor properly aligned on base - Compressor in good working condition

FIELD OF APPLICATION

- Open-type or semi-hermetic reciprocating compressors used in basic refrigeration systems

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to describe the characteristics of the construction and operation of various reciprocating compressors (A):

1. Describe the mode of operation of a simple reciprocating compressor.
2. Describe the parts of a simple reciprocating compressor.
3. Describe the methods of lubricating reciprocating compressors.
4. Identify the types of piston drives in reciprocating compressors.
5. Describe the types of crankcases in reciprocating compressors.
6. Identify the different drive mechanisms in compressors.
7. Describe the conditions that influence the volume displacement capacity of reciprocating compressors.

Before learning how to remove the compressor from the module (B):

8. Describe the procedures to follow before removing the compressor from a module charged with refrigerant.

Before learning how to disassemble the compressor (C):

9. Indicate the sequence for disassembling a reciprocating compressor.
10. Prepare the workbench for disassembling the compressor.

Before learning how to select replacement parts (D):

11. Check the condition of the parts of the compressor.
12. Recognize and locate, in service manuals, the identification numbers of the parts of the compressor.

Before learning how to assemble the compressor (E):

13. Detect defects in parts of reciprocating compressors.
14. Clean the parts of a compressor.
15. Describe the sequence and techniques for reassembling a compressor.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to install the compressor on the module and check its operation (F):

16. Make gaskets using sheet material.
17. Install seals, gaskets, glands and shaft seals.
18. Describe the procedures for checking a compressor before connecting it to the refrigeration system.
19. Check a reciprocating compressor before connecting it to the system.

MODULE 11: DIAGRAMS AND SKETCHES

CODE: 800 112 **Duration: 30 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
draw diagrams of components and circuits
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Following the teacher's instructions
- Using drawing sheets
- Using simple instruments, such as rules, compasses, templates and squares

GENERAL PERFORMANCE CRITERIA

- Accurate interpretation of diagrams
- Mastery of freehand sketching techniques
- Mastery of drawing techniques using instruments
- Quality diagrams and sketches:
  - clarity and precision
  - use of appropriate symbols
  - accurate representation of object or system

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Interpret diagrams of components or circuits of a refrigeration system.	- Recognition of objects represented - Accurate interpretation of symbols, lines and dimensions
B. Draw, in orthogonal projection, freehand sketches of components of a refrigeration system.	- Quality sketches: • proportionate • clear, precise lines • neat drawing • complete dimensioning • layout in accordance with drawing technique
C. Draw, in isometric or oblique projection, freehand sketches of components of a refrigeration system.	- Quality sketches: • proportionate • clear, precise lines • neat drawing • complete dimensioning • layout in accordance with drawing technique
D. Draw the diagram of a refrigerating circuit.	- Mastery of techniques for using drawing instruments - Quality diagram: • accurate representation of circuit • appropriate use of symbols • appropriate representation of the main components • clear, precise lines • neat diagram • complete dimensioning

FIELD OF APPLICATION

- Refrigeration and air conditioning
- Basic drawing techniques applied to refrigeration and air conditioning

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to interpret diagrams of components or circuits of a refrigeration system (A):

1. Describe the characteristics, function and use of basic drawing materials.
2. Interpret and reproduce standard lines.
3. Draw various geometric figures using drawing instruments.
4. Reproduce letters, words and numbers.
5. Interpret and reproduce symbols used in refrigeration and air conditioning (ASHRAE).
6. Interpret and reproduce simple graphic representations (front views) of the components of a refrigerating circuit.
7. Describe the basic elements of dimensioning.
8. Define stacking.
9. Interpret the dimensions on a diagram of the components or circuits of a refrigeration system.

Before learning how to draw, in orthogonal projection, freehand sketches of components of a refrigeration system (B):

10. Describe the basic elements of engineering sketches.
11. Use the basic sketching techniques.
12. Use the basic techniques for sketching orthogonal projections.

Before learning how to draw, in isometric or oblique projection, freehand sketches of components of a refrigeration system (C):

13. Identify the characteristics of isometric and oblique sketches.
14. Produce simple oblique and isometric sketches.

Before learning how to draw the diagram of a refrigerating circuit (D):

15. Draw the three main views of various objects.

MODULE 12: MOTOR CIRCUITS AND ELECTRICAL CONTROL ASSEMBLIES

CODE: 800 128 **Duration: 120 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
install a motor circuit and its electrical control assembly, and ensure that they function correctly
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working in a laboratory (the system need not be installed on an operational refrigeration system)
- Working on a driving system with:
  - a three-terminal, single-phase compressor, 125/24 V transformer
  - a condenser motor
  - an evaporator motor
  - starting and lock-out relays and run and starting capacitors
  - a motor starter
  - a temperature and a pressure control
- Following instructions
- Referring to specifications and a schematic or wiring diagram produced by the student
- Using the necessary tools and instruments
- Referring to drawings of the components and the appropriate technical documentation

GENERAL PERFORMANCE CRITERIA

- Accurate explanation of the operating principle of each system component
- Accurate explanation of the operating logic of the entire system
- Mastery of techniques for installing the system
- Mastery of techniques for adjusting the control assemblies

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

GENERAL PERFORMANCE CRITERIA (cont.)

- Quality circuit:
  - functional circuit
  - circuit in accordance with information in the specifications
  - observance of established standards and codes
  - neat work
- Appropriate description of procedures for maintaining the system
- Mastery of techniques for repairing the system

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Describe the characteristics and operating principles of the components listed in the specifications.	- Appropriate description of the main characteristics: • technical information, e.g. voltage, current, number of phases, cycle • type of connection • use of components (function, advantages, disadvantages) - Logical and clear explanation of the operating principle of the components
B. Draw schematic and wiring diagrams of the system.	- Clear diagrams - Use of correct symbols - Logical system - Accurate identification of components - Use of appropriate terminology - Attention to feasibility and economical considerations

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
C. Position and connect the components of the system.	- System in conformity with diagram - Quality connections - Neat wiring - Safe assembly in accordance with established standards and codes
D. Check the operation of the system.	- Appropriate verification technique - Appropriate use of measuring instruments - System in good operating condition and in accordance with specifications
E. Describe the preventive maintenance procedures for the system.	- Complete list of maintenance points - Realistic maintenance schedule - Accurate description of maintenance procedures (in accordance with manufacturer's standards)
F. Replace components of the system.	- Observance of teacher's instructions - Mastery of: • techniques for repairing components • selection of components • removal and disassembly techniques • assembly and installation techniques - System in good operating condition after repairs

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

FIELD OF APPLICATION

- Refrigeration and air conditioning
- All single-phase and three-phase motors, starters, contactors, starting relays, control relays, capacitors, lock-out relays, defrost timers and electrical control assemblies

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to describe the characteristics and operating principles of the components listed in the specifications (A):

1. Describe the characteristics of the construction of a single-phase electrical motor (split-phase).
2. Explain the operating principles of single-phase motors (split-phase).
3. Justify the use of different types of single-phase motors in refrigeration and air conditioning.
4. Locate the connection screws of a hermetic or semi-hermetic single-phase compressor.
5. Describe the operating principle of a test lead.
6. Start up a hermetic single-phase compressor with a test lead.
7. Explain the mode of operation of starting relays for hermetic or semi-hermetic compressors (split-phase).
8. Install starting relays and check their operation.
9. Explain the mode of operation of overload protectors on hermetic motor-compressors.
10. Install overload protectors on a hermetic compressor and check their operation.
11. Explain the mode of operation of capacitors for split-phase motors.
12. Install capacitors on a split-phase compressor and check their operation.
13. Describe the use of automatic temperature and pressure controls.
14. Describe the mode of operation of automatic temperature and pressure controls.
15. Describe the method of adjusting automatic temperature and pressure controls.
16. Install temperature and pressure controls and check their electrical operation.
17. Describe the mode of operation of transformers.
18. Install transformers (230/24 V and 125/24 V) and check their operation.
19. Describe the mode of operation of defrost timers.
20. Describe the mode of operation of contactors, starters, relays and electrical control assemblies.
21. Install contactors, starters, relays and electrical control assemblies and check their operation.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

22. Describe the characteristics of the construction of an electrical three-phase motor.
23. Explain the mode of operation of three-phase motors.
24. Justify the use of different types of three-phase motors in refrigeration and air conditioning.

Before learning how to draw schematic and wiring diagrams of the system (B):

25. Determine the electrical components that should be on the diagram by referring to the specifications.
26. Arrange correctly on the diagram the symbols for the electrical circuit to be assembled.

Before learning how to position and connect the components of the system (C):

27. Describe all the components to be installed.
28. Determine the position and fastening devices for the components of the system.
29. Prepare and install the wires between the electrical components of the system.

Before learning how to check the operation of the system (D), to describe the preventive maintenance procedures for the system (E) and to replace components of the system (F):

30. Explain the operating logic of the system.
31. Describe the procedures and instruments for checking the operation of the system.

MODULE 13: PIPING FOR REFRIGERATION SYSTEMS

CODE: 800 143 **Duration: 45 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
install the piping for a refrigeration or air conditioning system
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Using the necessary technical documentation
- Using the necessary tools and instruments
- Using all the components required to assemble the system

GENERAL PERFORMANCE CRITERIA

- Accurate explanation of the flow of refrigerant in the system
- Mastery of techniques for installing the piping (maximum diameter: 2⅛ in.)
- Logical sequence of installation operations
- Quality piping:
  - in accordance with plan and specifications
  - observance of *An Act respecting pressure vessels*
  - leakproof system
  - careful handling of components
  - neat work
- Observance of health and safety rules
- Clean tools and work areas
- Observance of time limits

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Justify the arrangement and size of the pipes used.	- Description of physical parameters: • density • relative density • velocity - Accurate description of relationship between the physical parameters, the size of the pipes and their arrangement
B. List the necessary tools and materials.	- Complete list - Appropriate provision for additional parts
C. Plan the work to be done.	- Detailed description of operations - Logical sequence of operations - Concern for efficiency - Preparation of a worksheet
D. Prepare the work areas and materials.	- Safe and appropriate preparation of work areas: • scaffolding • anchoring • utilities - Proper preparation of materials
E. Fasten and connect the piping (maximum diameter: 2⅛ in.).	- Mastery of techniques for preparing and fastening piping (maximum diameter: 2⅛ in.) - Mastery of techniques for welding and mechanically connecting the piping: • silfos welding, 45% silver • flare fittings, pipe couplings and flange joints - Quality welds

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
F. Check the system for leaks.	- Appropriate use of refrigerant and nitrogen - Appropriate use of leak detectors - System perfectly leakproof
G. Complete the worksheet.	- Worksheet properly filled in

FIELD OF APPLICATION

- Refrigeration and air conditioning
- Basic techniques for installing piping for refrigeration and air conditioning systems (maximum diameter: 2⅛ in.)

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to justify the arrangement and size of the pipes used (A):

1. Describe the different operations to be performed on the piping.
2. Describe the physical aspects of the refrigerant in each pipe of the refrigeration system.
3. Describe the factors that determine the flow speed of the refrigerant in the piping of the refrigeration system.
4. Describe effects of the velocity of the refrigerant.
5. Describe the different piping arrangements that can eliminate vibrations and expansion.
6. Describe the importance of good oil circulation in the system's piping.
7. Describe the piping arrangements that permit good oil circulation.
8. Calculate equivalent lengths of different pipes.

Before learning how to list the necessary tools and materials (B) and to plan the work to be done (C):

9. Choose anchors and supports.
10. Determine the size and quantity of openings required for the piping.

Before learning how to prepare the work areas and materials (D) and to fasten and connect the piping (maximum diameter: 2⅛ in.) (E):

11. Prepare the storage areas for materials and tools before installing the piping.
12. Prepare the work areas with safety in mind.

Before learning how to check the system for leaks (F) and to complete the worksheet (G):

13. Describe the different pressurization methods.
14. Describe pressurization and leak-detection equipment.
15. Select the method of pressurization.

MODULE 14: WALK-IN REFRIGERATORS

CODE: 800 158 **Duration: 120 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
perform tasks related to the installation of a walk-in refrigerator
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Planning the work
- Connecting an electrical circuit in a walk-in refrigerator whose condenser, evaporator and control assemblies are installed but not connected
- Using all the necessary technical documentation
- Using the necessary components, materials, tools and equipment
- Working on a system that has an electric or hot gas defrost

GENERAL PERFORMANCE CRITERIA

- Quality diagrams:
  - logic and clarity
  - complete and accurate identification of components
  - indication of all technical information concerning the operation of the system
- Mastery of techniques for assembling components and connecting circuits
- Mastery of methods and techniques for checking the system before start-up
- Mastery of procedures for starting up the system
- Walk-in refrigerator in good operating condition:
  - components working properly for a complete refrigeration cycle
  - observance of specific requirements regarding operating temperature
- Installation in accordance with established standards and codes
- Neat work and clean work areas
- Observance of health and safety rules
- Observance of time limits

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Draw a diagram of the piping system of the walk-in refrigerator.	- Quality diagram: • clarity • logic - Accurate explanation of circuit components and the lengths, diameters and slant of the refrigerant lines
B. Draw diagrams of the electrical circuit.	- Quality schematic diagram: • logic • clarity • use of correct symbols - Quality wiring diagram: • clarity • use of correct symbols and codes • feasibility and economical considerations
C. Plan the work to be done.	- Appropriate choice of tools and equipment - Proper preparation of purchase order for the necessary components: • identification of parts • size • quantity • model number - Sequential description of operations
D. Install and connect the components.	- Installation in accordance with diagrams - Observance of standards - Solid installations - Neat work

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
E. Check the system before start-up.	- Determination of all check points and verification procedures - Logical verification sequence - Mastery of verification techniques - Accurate diagnosis of the operating condition of the system - Determination of corrections and adjustments to be made prior to starting up the system
F. Adjust the components of the system.	- Accurate adjustments appropriate to: • superheat • thermostats and pressure controllers • post-defrost temperature • refrigerant charge - System operating in accordance with instructions
G. Complete the circuit diagrams.	- Accurate indication of information: • superheat • evaporator temperature • automatic controls

FIELD OF APPLICATION

- Refrigeration and air conditioning
- All commercial walk-in refrigerators with electrical or hot gas defrost mechanisms

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to draw a diagram of the piping system of the walk-in refrigerator (A):

1. Classify walk-in refrigerators according to their operating temperatures and air control processes.
2. Explain the refrigerating processes of walk-in refrigerators.
3. Describe the different defrosting procedures of evaporators in walk-in refrigerators.
4. Explain the mode of operation of defrost systems.
5. Describe the method of installing and connecting evaporator drains.
6. Describe the method of installing and connecting remote condensers.
7. Describe the method of installing and connecting water-cooled condensers.
8. Describe condensing pressure control devices.
9. Describe the automatic operating cycles of walk-in refrigerators and explain the technique involved.
10. Determine, on the basis of specifications, the components of a refrigeration system necessary to install a walk-in refrigerator.
11. Locate the symbols of a refrigeration system on a diagram.

Before learning how to draw diagrams of the electrical circuit (B):

12. Determine, on the basis of specifications, the components of an electrical circuit necessary to install a walk-in refrigerator.
13. Locate, on the schematic diagram of a walk-in refrigerator, the symbols of all the necessary electrical components.
14. Draw the wiring diagram of a walk-in refrigerator on the basis of the schematic diagram.
15. Explain the mode of operation of the electrical circuit.

Before learning how to plan the work to be done (C):

16. Determine the diameters and lengths of the copper piping required to install a walk-in refrigerator.
17. Determine the methods of connecting the different piping circuit components and accessories.
18. Determine the sequence of operations for installing a walk-in refrigerator.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to install and connect the components (D):

19. Select the locations for the components of the system.
20. Determine the anchoring devices for the piping and the mechanical and electrical components of the system.
21. Recognize all the tools required to install the walk-in refrigerator.
22. Prepare a list of the materials required to install the walk-in refrigerator.

Before learning how to check the system before start-up (E):

23. Check the system for leaks.
24. Dehydrate and evacuate the air from the refrigeration system.
25. Ensure that the current and voltage are appropriate to the components.
26. Check the oil level in the compressor.

Before learning how to adjust the components of the system (F):

27. Start up the system.
28. Charge the system.
29. Check the thermostatic expansion valve and the fluid regulators and adjust them if necessary.
30. Adjust the electrical controls of the walk-in refrigerator.
31. Check the protectors and safety switches of the refrigeration system.
32. Modify the refrigerating circuit of the walk-in refrigerator and integrate a pump-down system.
33. Install and connect the evaporator drain.
34. Check the operation of the defrost cycle.
35. Connect a water-cooled condenser.

Before learning how to complete the circuit diagrams (F):

36. Describe the methods of assessing the main operating parameters of a system.
37. Assess the operating parameters of a system.

MODULE 15: HEAT EXCHANGERS

CODE: 800 232 **Duration: 30 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
identify the characteristics of the construction, operation and use of heat exchangers
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Identifying construction and operation characteristics
- Using graphic representations of objects
- Following instructions

GENERAL PERFORMANCE CRITERIA

- Accurate description of the following aspects of heat exchangers:
  - types and components
  - types and modes of operation
  - criteria for selection and installation
  - maintenance procedures

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Identify the different types of heat exchangers.	- Accurate description of: • fluids used • direction of flow • location • connection • handling • anchoring devices
B. Explain the operating principle of different types of heat exchangers.	- Accurate explanation of: • the role of the heat exchanger within the system • the method of heat transfer
C. List the criteria for selecting a heat exchanger.	- Complete list of criteria
D. Describe the characteristics of the installation of heat exchangers.	- Appropriate description of: • fluids used • direction of flow • location • connection • handling • anchoring devices
E. Locate, on a plan or an actual installation, various places where heat could be recovered.	- Logical selections with reference to installation characteristics - Determination of the type of heat exchanger appropriate to each heat recovery point

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to identify the different types of heat exchangers (A):

1. Read the inlet and outlet temperatures of hot and cold fluids in a simple, double-tube heat exchanger in operation.
2. List the fluids most commonly used in heat exchangers in refrigeration and air conditioning.
3. List the ways of ensuring the passage of heat flux from one fluid to another.
4. Identify the types of fluid flow in heat exchangers.
5. Describe the characteristics of the materials used in manufacturing heat exchangers.
6. Recognize mechanical systems in the laboratory or school that are equipped with heat exchangers.
7. List systems in which heat exchangers may be used effectively to recover energy.

Before learning how to explain the operating principle of different types of heat exchangers (B):

8. Demonstrate the way in which heat transfer occurs in a fluid, using two small containers (one containing hot water, the other, coloured cold water).
9. Explain the principles of heat transfer in heat exchangers.
10. Explain the importance of the flow speed of fluids in heat exchangers.
11. Describe the function of a heat exchanger.

Before learning how to list the criteria for selecting a heat exchanger (C):

12. Determine the thermodynamic variables that influence the selection of a heat exchanger in a simple system in operation.
13. List the physical restrictions that can influence the selection of a heat exchanger.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to describe the characteristics of the installation of heat exchangers (D):

14. Locate the heat exchanger and its fluid pipes on a system in operation.
15. Indicate, on several systems, the type of anchoring device used to secure the heat exchanger and the type of connection used to connect it to the system.

Before learning how to locate, on a plan or an actual installation, various places where heat could be recovered (E):

16. Locate, in a bank of plans for projects related to various building mechanics or industrial processes, those that are the least energy-efficient.

MODULE 16: ELECTRONIC CONTROL CIRCUITS

CODE: 800 243 **Duration: 45 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
check the operation of an electronic control circuit
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Using a learning module on which all the operating conditions of the circuit can be simulated
- Using specifications describing the operating conditions of the circuit
- Using drawings and all the necessary technical documentation
- Using the necessary measuring instruments

GENERAL PERFORMANCE CRITERIA

- Accurate interpretation of circuit diagram, e.g. codes, lines, symbols
- Accurate explanation of the operating logic of the entire circuit
- Determination of an appropriate and thorough method of verification
- Mastery of techniques for checking the circuit
- Accurate description of the operating condition of the circuit

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Assemble a simple circuit using a transistor, a resistor, a capacitor and a diode.	- Complete description of components: • transistor • resistor • capacitor • diode
B. Ensure start-up of an AC motor using a thyristor.	- Clear diagram - Correct symbols - Logical circuit - Operational circuit
C. Assemble a simple counting circuit with a decimal binary decoder.	- Correct symbols - Logical, clear explanation of operating principle of components - Circuit in conformity with diagram - Operational circuit

FIELD OF APPLICATION

- Refrigeration and air conditioning
- All basic electronic devices commonly used in refrigeration and air conditioning, e.g. transistors, resistors, capacitors, diodes, thyristors, integrated circuits, temperature sensors, photosensitive cells

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to assemble a simple circuit using a transistor, a resistor, a capacitor and a diode (A):

1. Describe the function of resistors in electronic circuits.
2. Check the value of different resistors.
3. Describe the function of capacitors in circuits (resistor/capacitor).
4. Describe the function of diodes.
5. Check the behaviour of diodes, using an ohmmeter and a voltmeter.
6. Explain basic rectifier circuits.
7. Describe the function of bipolar transistors.
8. Check the transistors using an ohmmeter.

Before learning how to ensure start-up of an AC motor using a thyristor (B):

9. Describe the function of solid state relays.
10. Describe the function of photosensitive cells (cadmium cells).
11. Describe the function of thyristors.

Before learning how to assemble a simple counting circuit with a decimal binary decoder (C):

12. Describe the function of the logic gates.
13. Check the mode of operation of logic gates.
14. Describe a pure binary numeration system.
15. Describe the operating logic of a seven-segment LED display.
16. Describe the function of a seven-segment binary decoder.
17. Describe the function of a JK flip-flop.

MODULE 17: HEALTH AND SAFETY ON CONSTRUCTION SITES

CODE: 755 002 **Duration: 30 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

EXPECTED OUTCOME

By participating in the required activities of the learning context according to the indicated criteria, the students will be able to
apply concepts related to health and safety on construction sites.

SPECIFICATIONS

At the end of this module, the students will:

- Be familiar with the laws and regulations governing health and safety on construction sites.
- Be familiar with the roles and responsibilities of safety representatives and safety officers.
- Be familiar with the hazards and safety measures related to the performance of certain tasks.
- Be familiar with the hazards and safety measures related to the construction site itself.
- Be familiar with the hazards and safety measures related to the use of certain products.
- Know what to do in the event of an accident.

LEARNING CONTEXT

PHASE 1: **Information**

- Becoming familiar with the objective of the unit and companion guide.

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

LEARNING CONTEXT

PHASE 2: **Learning**

- Gathering information on the topic covered.
- Forming and expressing opinions on the topic.
- Asking questions.
- Identifying the main concepts and the underlying principles of safe behaviour.
- Assessing their adherence to these principles.

PHASE 3: **Reinforcement**

- Reviewing the main concepts of the unit.
- Answering a series of questions.
- Correcting the answers and discussing them if necessary.

INSTRUCTIONAL GUIDELINES

The teacher should:

- Ensure access to a suitable room and proper materials.
- Present the material in an interesting manner.
- Encourage students to participate in group discussions.
- Make good use of teaching materials (e.g. tables, transparencies, films, videotapes, cards).

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

PARTICIPATION CRITERIA

- Participate in at least 18 of the 20 units, units 1 and 2 being compulsory.
- Listen attentively.
- Stick to the topic during discussions.
- Ask pertinent questions and give appropriate answers.
- Do the exercises conscientiously.
- Correct any errors.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before undertaking the activities of Phase 1:

1. Be receptive to information related to health and safety.
2. Be willing to share their knowledge with the other members of the group.

Before undertaking the activities of Phase 2:

3. Gather information.
4. Determine a way of presenting information.
5. Explain the main rules governing group discussion.

Before undertaking the activities of Phase 3:

6. Describe the method of answering a series of questions.

MODULE 18: FLUID SYSTEM REGULATORS AND ACCESSORIES

CODE: 800 134 **Duration: 60 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
ensure that the fluid system regulators and accessories are functioning correctly
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Following instructions
- Given hypothetical situations

GENERAL PERFORMANCE CRITERIA

- Accurate description of the characteristics of the construction and operation of fluid system regulators and accessories
- Accurate description of techniques for installing regulators and accessories
- Clear explanation of the function and operating principle of the fluid system regulators and accessories of a given system
- Mastery of techniques for checking and adjusting fluid system regulators
- Conformity with specifications concerning the operation of regulators
- Observance of time limits
- Regulators in good working order
- Observance of health and safety rules

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Describe the characteristics and mode of operation of certain fluid system regulators and accessories.	- Use of the appropriate terminology - Appropriate description of characteristics: • construction • technical information • use - Function of regulators and accessories in a system - Clear and logical explanation of the operating principle of the components
B. Describe the factors to be taken into account when determining the location of fluid system regulators and accessories.	- Appropriate description of factors related to the operation and maintenance of the components and the safety of the system
C. Describe the techniques for installing fluid system regulators and accessories.	- Description in accordance with manufacturer's recommendations
D. Draw a diagram of the fluid system of a given refrigeration system.	- Clear, logical diagram - Recognition and accurate location of system regulators and accessories
E. Check fluid system regulators and accessories.	- Determination of all check points and verification procedures - Logical verification sequence - Mastery of verification techniques - Accurate diagnosis of the operating condition of the regulators and accessories
F. Adjust fluid system regulators.	- Mastery of techniques for adjusting each regulator - Regulators in good working order

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

FIELD OF APPLICATION

- Refrigeration and air conditioning
- All regulators and accessories used in the fluid systems of refrigeration and air conditioning systems, particularly: regulators (crankcase pressure regulators, pressure controllers, condensation regulators, two-temperature valves) and accessories (e.g. oil separators, safety valves)

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to describe the characteristics and mode of operation of certain fluid system regulators and accessories (A), to describe the factors to be taken into account when determining the location of fluid system regulators and accessories (B) and to describe the techniques for installing fluid system regulators and accessories (C):

1. Describe the functions of accessories in complex refrigerating circuits.
2. Describe the functions of fluid system regulators in complex refrigerating circuits.
3. Describe the operating characteristics of accessories that filter refrigerants.
4. Describe the techniques for installing dehydrators and filters in fluid systems.
5. Describe the operating characteristics of liquid indicators.
6. Describe the techniques for installing moisture indicators and sight glasses.
7. Describe the operating characteristics of accessories that increase the cooling effect of evaporators.
8. Describe the techniques for installing heat exchangers (liquid and suction pressure).
9. Describe the operating characteristics of vibration eliminators and mufflers.
10. Describe the techniques for installing vibration eliminators and mufflers.
11. Describe the operating characteristics of the accessories that maintain the oil level in a compressor.
12. Describe the techniques for installing vents, oil separators and oil-level controllers on compressors.
13. Describe the operating characteristics of the accessories that eliminate slugging (accumulators).
14. Describe the techniques for installing accumulators.
15. Describe the operating characteristics of the water regulating valves in water-cooled condensers.
16. Describe the techniques for installing water regulating valves.
17. Describe the operating characteristics of manual and electrically operated valves.
18. Describe the techniques for installing manual and electrically operated valves.
19. Describe the operating characteristics of evaporator pressure regulators.
20. Describe the techniques for installing evaporator pressure regulators.
21. Describe the operating characteristics of condensing pressure regulators.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

22. Describe the techniques for installing condensing pressure valves.
23. Describe the operating characteristics of crankcase pressure regulators in a compressor crankcase.
24. Describe the techniques for installing crankcase pressure regulators.
25. Describe the operating characteristics of hot gas bypass valves on compressors.
26. Describe the techniques for installing hot-gas bypass valves on compressors.
27. Describe the operating characteristics of the regulators that control the direction of flow.
28. Describe the techniques for installing check valves.
29. Describe the operating characteristics of relief valves.
30. Describe the techniques for installing relief valves.

Before learning how to draw a diagram of the fluid system of a given refrigeration system (D):

31. Locate different fluid system regulators and accessories on drawings and refrigeration installations.

Before learning how to check fluid system regulators and accessories (E) and to adjust fluid system regulators (F):

32. Describe the techniques for checking refrigerating circuit accessories.
33. Describe the techniques for checking and adjusting fluid system regulators.

MODULE 19: REFRIGERATED DISPLAY CASES

CODE: 800 164 **Duration: 60 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
ensure that a refrigerated display case is functioning correctly
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Given hypothetical situations
- Given start-up and operating problems

GENERAL PERFORMANCE CRITERIA

- Appropriate description of the characteristics of the construction, operation and use of the main types of refrigerated display cases
- Mastery of techniques for checking refrigeration systems
- Accurate diagnoses
- Appropriate proposed corrections
- Mastery of techniques for repairing refrigerated display cases
- Mastery of techniques for starting up refrigeration systems
- Quality work:
  - system operating according to established standards
  - neat system and work areas
- Observance of time limits
- Observance of health and safety rules

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Identify the characteristics of the construction and operation of different types of refrigerated display cases.	- Appropriate characteristics - Quality construction and schematic diagrams - Appropriate description of methods of air distribution and circulation - Appropriate description of the main uses of various types of display cases
B. Analyze the operating condition of a refrigerated display case.	- Accurate list of check points - Accurate description of verification procedures - Logical sequence of verification operations - Mastery of verification techniques
C. Diagnose the problem and determine the appropriate corrective measure.	- Accurate diagnosis - Appropriate corrective measures
D. Make the required correction.	- Mastery of techniques for removing and installing components - Careful handling of display case and components - Observance of manufacturer's standards
E. Start up the refrigerated display case.	- Observance of start-up procedures - Appropriate adjustment of regulators and controls - Appropriate quantity of refrigerant and oil - System operating according to established standards

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
F. Prepare a service report or an invoice.	- Clear, concise report - Complete description of work done - Accurate invoice: • name and address of client • brief description of system • recommendations • description of work done • duration of work • travelling time • cost of parts • taxes • accurate calculations

FIELD OF APPLICATION

- Refrigeration and air conditioning
- Main types of refrigerated display cases, e.g. high, medium, low, very low temperature, direct- or indirect-expansion, with or without heat reclaimer

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to identify the characteristics of the construction and operation of different types of refrigerated display cases (A):

1. Identify the different models of refrigerated display cases.
2. Describe the temperature and humidity level in a refrigerated display case.
3. Describe the influence of ambient conditions on the operation of refrigerated display cases.
4. Describe the types of insulation used in display cases.
5. Explain the principle of refrigerated air circulation in display cases.
6. Describe the defrost methods of display case evaporators.
7. Describe the wastewater circuit in refrigerated display cases.
8. Describe the lighting systems used in refrigerated display cases.

Before learning how to analyze the operating condition of a refrigerated display case (B):

9. Identify various arrangements for connecting display cases to compressors.
10. Describe the mode of operation of several display cases connected to one or more compressors.
11. Explain the mode of operation of an electrical defrost system.
12. Explain the mode of operation of a hot gas defrost system.
13. Check the operation of the air circulation system of a display case.
14. Check the operation of the refrigerating circuit of a display case.
15. Check the operation of the defrost cycle of a display case.

Before learning how to diagnose the problem and determine the appropriate corrective measure (C):

16. List the probable causes of poor air circulation in a refrigerated display case.
17. List the probable causes of frost accumulation on the evaporator.
18. List the probable causes of too-high temperature in a refrigerated display case.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to make the required connection (D):

19. Describe the methods of cleaning the drainage system.
20. Ensure that the lighting system of a display case is in good operating condition.
21. Replace the evaporator fan motor in a refrigerated display case.
22. Adjust the expansion valve.
23. Adjust the temperature controls of display cases.
24. Adjust the safety switches.
25. Adjust the defrost timer.
26. Check the type of refrigerant used in the refrigeration system of a display case.

Before learning how to start up the refrigerated display case (E):

27. Check and adjust the oil level in the compressor.
28. Charge the refrigerant in the refrigeration system.
29. Adjust the condensing pressure regulators.
30. Adjust the crankcase pressure regulator of the compressor of a refrigerated display case (overload).
31. Adjust a two-temperature valve (evaporator pressure regulator).

Before learning how to prepare a service report or an invoice (F):

32. Describe the information required to produce a report or invoice.
33. Locate and note technical information on the nameplates of a display case.

MODULE 20: VENTILATION AND AIR CONDITIONING PROCESSES

CODE: 800 226 **Duration: 90 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
analyze various ventilation and air conditioning processes
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Given a hypothetical situation
- Analyzing various ventilation and air conditioning processes
- Without using technical documentation

GENERAL PERFORMANCE CRITERIA

- Accurate explanation of ventilation and air conditioning principles
- Accurate calculations
- Accurate representation of the main air conditioning processes on the psychrometric chart
- Mastery of techniques for using the measuring instruments and tools specific to ventilation and air conditioning work
- Appropriate use of terminology
- Appropriate description of health and safety rules

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Illustrate various air conditioning processes on a psychrometric chart.	- Complete list of the components for the various processes - Appropriate information on the physical parameters considered - Accurate representation of processes: • heating • cooling • humidifying • dehumidifying
B. Describe various ventilation processes.	- Accurate explanation of ventilation principles - Appropriate description of processes, taking into account: • the exact definition of the basic concepts (e.g. static pressure, velocity pressure, total pressure, volume, surfaces, temperature) • the exact determining physical parameters • air movement • air changes • air flow (volume and velocity)

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
C. Describe various air conditioning processes.	- Accurate explanation of air conditioning principles: • cooling • heating • humidifying • dehumidifying • air changes • air movement • noise • air filtering - Accurate description of processes, taking into account: • the exact definition of the basic concepts • the exact determining physical parameters • the correct description of the main components and their function
D. Do the calculations related to the application of ventilation and air conditioning principles.	- Accurate calculations: • air flow, velocity, air mixture • fans: flow, static pressure, horsepower
E. Describe the characteristics of and the technique for using the measuring instruments used in ventilation and air conditioning.	- Complete list of measuring instruments - Accurate description of the operating principles of the measuring instruments - Appropriate description of the methods of using the instruments: • selection of instrument • scale • connection • reading

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

FIELD OF APPLICATION

- Refrigeration and air conditioning
- Main uses of air conditioning and ventilation systems: heating, cooling, humidifying, dehumidifying

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to illustrate various air conditioning processes on a psychrometric chart (A):

1. Describe the processes related to air treatment.
2. Explain the conditions that affect human comfort in a building.
3. List the components of air.
4. List the properties of air.
5. Define the terms used in psychrometry.
6. Use a sling or wall psychrometer.
7. Indicate or read information on a psychrometric chart.
8. Solve practical problems using a psychrometric chart.

Before learning how to describe various ventilation processes (B):

9. Recognize the air distribution systems in a building.
10. Describe the operation of air distribution systems in a building.
11. Identify the accessories of air distribution systems and locate them on a drawing.
12. Describe the operation of the various accessories of air distribution systems.
13. Identify the physical parameters related to ventilation.

Before learning how to describe various air conditioning processes (C):

14. Describe air conditioning and heating systems.
15. Determine the size and shape of air ducts.
16. Calculate the quantity of air to be diffused in an area on the basis of ventilation, heating and air conditioning charges.
17. Identify the types of forced air filters.
18. Describe the mode of operation of air filters.
19. Demonstrate the method of maintaining ventilation system filters.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to do the calculations related to the application of ventilation and air conditioning principles (D):

20. Identify the types of ventilators.
21. Describe the characteristics and mode of operation of ventilators.
22. Demonstrate the method of maintaining ventilators.
23. Describe the methods and principles related to the adjustment of ventilators.
24. Check the information concerning air flow ($ft.^3$/min), referring to the plans and specifications.
25. Describe the methods used to record air speed (ft./min) and flow ($ft.^3$/min) in air conditioning and heating equipment.

Before learning how to describe the characteristics of and the technique for using the measuring instruments used in ventilation and air conditioning (E):

26. Make the necessary adjustments to an air distribution system to make up the difference between the test results and the information in the plan or specifications.

MODULE 21: MAINTAINING AND TROUBLESHOOTING SELF-CONTAINED AIR CONDITIONING UNITS

CODE: 800 264 **Duration: 60 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must **ensure that a self-contained air conditioning unit is functioning correctly** in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Given hypothetical situations
- Using plans and the necessary technical documentation

GENERAL PERFORMANCE CRITERIA

- Accurate description of the mode of operation of the air conditioning unit
- Accurate diagnoses of the operational problems
- Mastery of techniques for removing and installing the air conditioning unit
- Mastery of techniques for disassembling and assembling the components
- Appropriate selection of replacement components
- Mastery of techniques for starting up the unit
- Unit operating in accordance with manufacturer's standards
- Observance of health and safety rules
- Observance of time limits

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Identify the characteristics of the construction and operation of the main types of self-contained air conditioning units.	- Accurate description of: • refrigerant • main components • method of installation • required utilities • capacity - Accurate description of air circulation principles
B. Carry out a preliminary analysis of the unit.	- Logical verification operations - Justification for removing unit
C. Remove the unit.	- Mastery of removal techniques: • no damage to unit • no damage to support • no damage to work area
D. Analyze the system.	- Interpretation of maintenance manual: • electrical circuit • air circuit • refrigerating circuit • exploded views (disassembly) • technical information - Determination of verifications appropriate to symptoms described - Accurate diagnosis of the operating condition of the components
E. Determine the corrections to be made to the unit.	- Corrections appropriate to diagnosis - Appropriate choice of replacement components, if necessary

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
F. Make the corrections to the unit.	- Mastery of techniques: • cleaning • adjusting • charging unit • replacing components • lubricating
G. Check the operation of the unit.	- Correct execution of efficiency tests: • air flow • compressor • superheat of evaporator • noise and vibrations - Unit operating in accordance with manufacturer's standards
H. Install the unit on its support.	- Solid, leakproof and safe installation - Neat installation - No damage
I. Prepare a service report or invoice.	- Clear, concise report - Complete description of work done - Accurate invoice: • name and address of client • brief description of unit • recommendations • description of work done • duration of work • travelling time • cost of parts • taxes

FIELD OF APPLICATION

- Refrigeration and air conditioning
- All self-contained air conditioning units

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to identify the characteristics of the construction and operation of the main types of self-contained air conditioning units (A):

1. Identify self-contained air conditioning units.
2. List the devices and utilities required for the operation of a self-contained air conditioning unit.
3. List the measures to be taken for the safe and operational installation of a self-contained air conditioning unit.
4. Describe the air circuit in self-contained air conditioning units with air- or water-cooled condensers.
5. Explain the route of used water through the condenser of a self-contained air conditioning unit.
6. Explain the route of condensed water through the evaporator of a self-contained air conditioning unit.
7. List and justify the types of fans used in self-contained air conditioning units.
8. Indicate and explain the mode of operation of the components of the refrigerating circuit of a self-contained air conditioning unit.
9. Indicate and explain the mode of operation of the electrical components of a self-contained air conditioning unit.
10. Explain the operating logic of the heating systems incorporated into self-contained air conditioning units.

Before learning how to carry out a preliminary analysis of the unit (B):

11. Calculate the air conditioning and heating capacity of different self-contained air conditioning units.
12. Determine the heat load of rooms to be air conditioned by self-contained air conditioning units (short method).
13. Check the operation of the electrical circuit and its components.
14. Check the operation of the refrigerating circuit and its components.
15. Identify and explain the causes of compressor blockage.

Before learning how to remove the unit (C):

16. Describe the devices and methods used for removing and handling self-contained air conditioning units and their components.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to analyze the system (D):

17. Check the operation of the air circuit of a self-contained air conditioning unit.

Before learning how to determine the corrections to be made to the unit (E):

18. Determine which components of a self-contained air conditioning unit can be adjusted or repaired.
19. Select replacement parts or components from the manufacturer's manuals or catalogues.

Before learning how to make the corrections to the unit (F):

20. Describe the methods of cleaning condensers, evaporators and filters.
21. Explain the methods of charging refrigerants and oils.
22. Describe the techniques for checking and oiling fan motor bearings.
23. Explain the methods of adjusting thermostats.
24. Weld evaporators and aluminum tubes.
25. Install access valves (self-piercing) on the refrigerating circuit of the unit.
26. Remove the pressure gauges and seal the charge tubes of the refrigeration system.
27. Cut the capillary tubes and weld them to the components of the refrigeration system.
28. Explain the methods of replacing the components of a self-contained air conditioning unit.
29. Install starting kits.

Before learning how to check the operation of the unit (G) and to install the unit on its support (H):

30. Check the operation of the adjusted or repaired components.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to prepare a service report or invoice (I):

31. Adjust the water regulating valves on the condenser of a self-contained air conditioning unit.
32. Adjust and check the operation of temperature and pressure safety switches.
33. Locate and note the relevant technical information on a nameplate.
34. Describe the parts of a service report and an invoice and their purpose.

MODULE 22: INSTALLING SPLIT-SYSTEM HEAT PUMPS

CODE: 800 277 **Duration: 105 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
perform tasks related to the installation of a unitary or add-on split-system heat pump
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Given problems related to:
  - the selection of locations for the components of the unit
  - techniques for preparing the supports
  - passages for the pipes and cables
- Given hypothetical situations in the workshop
- Using an air-to-air unitary or add-on split-system heat pump
- Using a split-system heat pump installed on its support
- Using the necessary plans, diagrams and technical documentation
- Using the necessary tools, measuring instruments, equipment and materials

GENERAL PERFORMANCE CRITERIA

- Accurate description of the modes of operation of heat pumps
- Appropriate justification of the choice of locations for the sections and for certain controls
- Appropriate preparation of the work areas (accessibility of utilities)
- Mastery of techniques for installing heat pumps and making the mechanical and electrical connections
- System operating in accordance with manufacturer's requirements and recommendations
- Observance of health and safety rules
- Observance of ergonomic rules for the transportation and handling of loads
- Cleanliness of work areas
- Observance of time limits

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Identify the characteristics of the construction and operation of split-system heat pumps.	- Appropriate comparisons - Realistic descriptions: • characteristics • operating principle
B. Describe the heat pump to be installed.	- Accurate description of the system components and their function - Accurate description of the operating principle of the system
C. Justify the choice of locations for the sections of a heat pump (simulation).	- Appropriate determination of variables to take into account when choosing locations: • electrical furnace • oil furnace • gas furnace - Logical explanations
D. Describe the techniques for preparing the locations selected for the installation of the sections of a heat pump (simulation).	- Accurate description of preparation techniques: • support • drilling • utilities • anchoring devices
E. Plan the work to be done.	- Complete list of the necessary components, accessories and tools - Logical sequence of operations for installing and starting up the heat pump

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
F. Install the system.	- Quality connections: • neat • leakproof • damage-free - Observance of established standards and codes - Appropriate installation of evaporator, control devices, drains and water supply - Installation in accordance with information in plan
G. Start up the system.	- Mastery of method and techniques for starting up the system: • efficiency tests • voltage and current • leakproof system • operating pressure • air flow in furnace - System well balanced and in good operating condition - Observance of manufacturer's standards
H. Describe periodic maintenance procedures for the system to a client (simulation).	- Clear and appropriate explanations: • operation of the system • verification technique and maintenance method
I. Prepare a service report.	- Complete report of work done - Clear, concise report

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

FIELD OF APPLICATION

- Refrigeration and air conditioning
- Tasks related to the installation and start-up of split-system air conditioners and air-to-air or water-to-air heat pumps (unitary or add-on residential or small commercial systems)

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to identify the characteristics of the construction and operation of split-system heat pumps (A):

1. Identify the types of split-system air conditioners and heat pumps.
2. Describe the basic operating principle of heat pumps.
3. Describe the operating logic of an oil furnace (forced air).
4. Describe the operating logic of an electrical furnace (forced air).
5. Describe the operating logic of a gas furnace (forced air).
6. Describe the mode of operation of wall thermostats used in heating and twin-control thermostats used in air conditioning and heating.
7. Explain the mode of operation of a split-system heat pump (air- or water-cooled condenser) added on to an electrical furnace.
8. Explain the mode of operation of a split-system heat pump (air- or water-cooled condenser) added on to an oil furnace.
9. Explain the mode of operation of a split-system heat pump (air- or water-cooled condenser) added on to a gas furnace.
10. Describe the characteristics of the construction and operation of the components of a unitary heat pump.

Before learning how to describe the heat pump to be installed (B) and to justify the choice of locations for the sections of a heat pump (simulation) (C):

11. Describe and justify the location of the evaporator added on to furnaces used for air conditioning.
12. Describe and justify the location of the condenser in a split-system heat pump.
13. Justify the choice, arrangement and installation of the refrigeration piping installed on split-system air conditioners and heat pumps.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to describe the techniques for preparing the locations selected for the installation of the sections of a heat pump (simulation) (D):

14. Describe the techniques for preparing and installing the cooling coil (evaporator).
15. Describe the techniques for preparing and installing air- or water-cooled condensers.
16. Describe the techniques for preparing and installing the electrical components of a split-system heat pump.
17. Describe the techniques for preparing and installing the piping for a split-system heat pump.

Before learning how to plan the work to be done (E):

18. Describe all the utilities required for the operation of split-system air conditioners and heat pumps.
19. Check the air flow of the existing furnace.
20. Assess the modifications to be made to the principal and secondary air ducts (return and distribution).
21. List all the components, accessories, tools and materials required to install the various heat pumps.

Before learning how to install the system (F):

22. Draw a diagram of the connection of the refrigerating circuit of split-section air conditioners and heat pumps.
23. Draw a diagram of the electrical connection of split-system air conditioners and heat pumps.
24. Draw a diagram of the electrical connection of accessories installed on split-system air conditioners and heat pumps.

Before learning how to start up the system (G):

25. Describe the verifications to be made and the precautions to be taken before starting up the system.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to describe periodic maintenance procedures for the system to a client (simulation) (H):

26. Locate the maintenance points (annual maintenance) on a split-system heat pump and describe the type of maintenance necessary.
27. Check the operating condition of various installed air conditioners and heat pumps.

Before learning how to prepare a service report (I):

28. Locate, on a system, the information required to recognize its components.
29. List the information found in service reports and invoices.

MODULE 23: MAINTAINING AND TROUBLESHOOTING HEAT PUMPS

CODE: 800 365 **Duration: 75 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
ensure that a heat pump is functioning correctly
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Performing maintenance and troubleshooting tasks
- Using heat pumps installed in the workshop in accordance with manufacturer's standards
- Maintenance work carried out according to instructions
- Using the necessary plans and technical documentation
- Using the necessary tools, instruments and components
- Troubleshooting simulated or real problems created by the teacher
- Repairing the system

GENERAL PERFORMANCE CRITERIA

- Appropriate description of method of maintaining heat pumps
- Mastery of techniques for analyzing the system
- Accurate diagnoses and appropriate corrective measures
- Mastery of techniques for repairing and starting up the system
- System operating in accordance with manufacturer's standards
- Quality service report and invoice
- Observance of health and safety rules
- Observance of time limits

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Determine the verification procedure for the maintenance of a heat pump.	- Complete list of check points - Accurate description of verification procedures and work to be done at each point
B. Describe the process of analyzing the operational problems of a system.	- Logical sequence of operations - No unnecessary checks
C. Diagnose the problem and indicate the corrections to be made to the system.	- Accurate diagnosis - Appropriate corrections
D. Make the corrections to the system.	- Mastery of techniques for repairing components: • selection of replacement parts • removal and installation • disassembly and assembly
E. Start up the system.	- Mastery of techniques for starting up the system: • efficiency tests • control sequence • voltage and current • operating pressure • air flow in the furnace - System well balanced and functioning correctly - Observance of manufacturer's standards

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
F. Prepare a service report or an invoice.	- Clear, concise report - Complete report of work done - Accurate invoice: • name and address of client • brief description of system • recommendations • description of work done • travelling time • duration of work • cost of parts • taxes

FIELD OF APPLICATION

- Refrigeration and air conditioning
- Mainly unitary and add-on split-system and self-contained heat pump repair

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to determine the verification procedure for the maintenance of a heat pump (A):

1. Be familiar with the check points for the preventive maintenance of various heat pumps.
2. Describe the techniques for checking each point.
3. Carry out a complete verification of various heat pumps for preventive maintenance purposes.
4. Carry out preventive maintenance on a heat pump.

Before learning how to describe the process of analyzing the operational problems of a system (B):

5. Describe and justify the importance of each step in the problem-solving process.

Before learning how to diagnose the problem and indicate the corrections to be made to the system (C) and to make the corrections to the system (D):

6. Analyze the operating condition of the compressor of a heat pump.
7. Solve operational problems affecting the compressor of various heat pumps.
8. Analyze the operating condition of the exterior coil of various heat pumps.
9. Solve operational problems affecting the exterior coil of various heat pumps.
10. Analyze the operating condition of the interior coil of various heat pumps.
11. Solve operational problems affecting the interior coil of various heat pumps.
12. Check the refrigerating circuit of a heat pump.
13. Solve operational problems affecting the refrigerating circuit of a heat pump.
14. Check the electrical circuit of a heat pump.
15. Solve operational problems affecting the electrical circuit of a heat pump.
16. Check the operating logic of the microprocessor of a heat pump.
17. Make a diagnostic chart of the most common operational problems affecting heat pumps.
18. Be aware of the importance of an efficient and methodical approach to solving operational problems affecting heat pumps.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to start up the system (E):

19. Describe the techniques for starting up a heat pump.
20. Carry out various verifications of a heat pump following the correction of an operational problem.

Before learning how to prepare a service report or an invoice (F):

21. Describe the content of a service report for starting up a heat pump.
22. Describe the content of an invoice.

MODULE 24: PLANS AND SPECIFICATIONS

CODE: 800 252 **Duration: 30 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
read and interpret plans and specifications
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Given hypothetical situations
- Using the structural and mechanical plans of a building
- Using the specifications of a refrigeration system
- Following instructions for locating the components of a system (from plan to system or vice-versa)

GENERAL PERFORMANCE CRITERIA

- Accurate interpretation of information in a plan or specifications
- Accurate description of a refrigeration system on the basis of related plans and specifications
- Accurate location of components (from plan to system or vice-versa)

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Describe the nature of the general information contained in a plan.	- Accurate description of: • legend • scale • symbols and lines • materials and codes
B. Recognize the sheets that make up the structural and mechanical plans of a building.	- Accurate identification of the sheets: • working drawings • structural plans • electrical plans • plumbing plans • heating and air conditioning plans • refrigeration plans
C. Interpret the codes and symbols related to a refrigeration or air conditioning system.	- Accurate interpretation of codes and symbols: • electrical circuits • fluid circuits
D. Describe a refrigeration or air conditioning system represented on a plan.	- Accurate description of: • system components • characteristics of system and components • function and operating conditions of system
E. Locate, on a plan, the components of a refrigeration or air conditioning system.	- Accurate location of components on plan
F. Locate, on a refrigeration or air conditioning system, the components represented on a plan.	- Accurate location of components of system
G. Describe the nature of the information in the specifications of a refrigeration system.	- Accurate description of information

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

FIELD OF APPLICATION

- Refrigeration and air conditioning
- Plans and specifications commonly used in refrigeration and air conditioning

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to describe the nature of the general information contained in a plan (A):

1. Differentiate among the different sheets that make up a set of plans.
2. Recognize simple elements (e.g. doors, windows, rooms) on one of the plans of the school.
3. Locate, in the school, a door, window or room previously located on one of the plans of the school.
4. Recognize the most commonly used systems for filing plans.
5. Recognize north on a plan.
6. Recognize the information in the legends of a set of plans.
7. Recognize the types of filing systems for plans.
8. Interpret the conventional lines on a plan.

Before learning how to recognize the sheets that make up the structural and mechanical plans of a building (B):

9. Identify the graphical elements of an object.
10. Identify the types of plans according to their use.
11. Identify the different types of drawings according to the type of graphical representation used.
12. Identify the classical views in the drawings.
13. Identify the types of cross-sectional drawings in the plans.
14. Identify the auxiliary views.
15. Recognize the graphical representations of the materials and elements used in construction.
16. Recognize the types of walls in architectural plans.
17. Recognize the types of ceilings in architectural plans.
18. Describe the floor areas according to their use and the nature of the building, on the basis of architectural plans.
19. Interpret the different conventions of technical drawing.
20. Differentiate among engineering plans according to the field of specialization.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to interpret the codes and symbols related to a refrigeration or air conditioning system (C):

21. Select the mechanical plans in a set of plans.
22. Select the mechanical plans related to the refrigeration and air conditioning installations of a project.
23. Interpret the traditional refrigeration symbols with a view to using the plans.
24. Select the electrical plans in a set of plans.
25. Select the connection plans for the refrigeration and air conditioning systems.
26. Interpret air conditioning and electrical symbols with a view to using the plans.

Before learning how to describe a refrigeration or air conditioning system represented on a plan (D):

27. Locate the components of a refrigeration or air conditioning system on a plan.
28. Interpret the diagrams and symbols representing the piping for a refrigeration system.
29. Interpret the types of tables shown in the plans.
30. Interpret the legend provided as a reference.
31. Select reference materials for researching missing information.
32. Read and interpret the reference materials related to refrigeration and air conditioning, taking into account the required information.

Before learning how to locate, on a plan, the components of a refrigeration or air conditioning system (E) and to locate, on a refrigeration or air conditioning system, the components represented on a plan (F):

33. Locate the components of a refrigeration or air conditioning system in the workshop.
34. Select the mechanical plans in the plans of the school.
35. Select the mechanical plans related to the refrigeration or air conditioning system of the workshop.
36. Interpret refrigeration, air conditioning and electrical symbols with a view to using a plan.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to describe the nature of the information in the specifications of a refrigeration system (G):

37. Recognize a component (e.g. a compressor) on a mechanical plan.
38. Consult specifications and locate the technical requirements that a given component (e.g. a compressor) must meet in order to satisfy the requirements of a project.
39. Check whether an installed component (e.g. a compressor) complies with the technical requirements stated in the specifications.
40. Explain the use of specifications in construction projects.
41. Recognize the main items found in specifications.
42. Consult specifications for existing mechanical installation projects.
43. Describe the technical information that should be included in specifications, using certain criteria.
44. Consult specifications and describe the technical requirements for a project.

MODULE 25: CENTRIFUGAL PUMPS

CODE: 800 322 **Duration: 30 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
describe and check the operation of centrifugal pumps
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Given hypothetical situations
- Following instructions (theory)
- Describing the operating principle of centrifugal pumps (theory)
- Describing the methods of connecting centrifugal pumps (theory)

GENERAL PERFORMANCE CRITERIA

- Appropriate description of the operating principle of centrifugal pumps
- Appropriate description of the characteristics of the construction and operation of centrifugal pumps
- Mastery of techniques for checking centrifugal pumps
- Use of appropriate terminology

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Describe the operating principle of centrifugal pumps.	- Recognition of the basic components of a centrifugal pump - Accurate definition of concepts: • centrifugal effect • velocity pressure • dynamic pressure - Accurate description of the liquid: • pressure • density • viscosity
B. Identify the types of centrifugal pumps.	- Knowledge of centrifugal pumps - Accurate description of the characteristics of the construction and operation of centrifugal pumps - Accurate description of the advantages and disadvantages of centrifugal pumps
C. Check the efficiency of a centrifugal pump.	- Knowledge of the physical parameters (variables) to be considered - Mastery of verification procedures: • check points • nature of verifications • readings - Correct interpretation of output diagram
D. Describe the main methods of connecting centrifugal pumps.	- Accurate description of connection methods: • flange joints • threaded connections

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

FIELD OF APPLICATION

- Refrigeration and air conditioning
- Main types of centrifugal pumps: single-impeller, multi-stage, submersible

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to describe the operating principle of centrifugal pumps (A):

1. Locate the centrifugal pump in a simple installation (refrigeration or air conditioning system).
2. Describe the components of a centrifugal pump, referring to a cross-sectional view or a disassembled unit.
3. Calculate the static pressure produced by a water column ($P_s = ph$).
4. Calculate the velocity pressure produced by the movement of water in a conduit ($P_v = N^2/2g$).
5. Measure the total pressure using a venturi and a U-manometer ($P_z = P_s + P_v$).
6. Deduce the velocity pressure by measuring the total pressure and calculating the static pressure.
7. Identify simple devices whose operation is based on the use of centrifugal force.
8. Describe the characteristics of the impeller or turbine of a simple centrifugal pump.
9. State the function of the impeller or turbine of a simple centrifugal pump.
10. Describe the characteristics of the shell of a simple centrifugal pump.
11. Describe the components of a simple centrifugal pump.

Before learning how to identify the types of centrifugal pumps (B):

12. Identify the characteristics of radial flow centrifugal pumps.
13. Identify the characteristics of axial flow centrifugal pumps.
14. Identify the characteristics of axial-radial centrifugal pumps.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to check the efficiency of a centrifugal pump (C) and to describe the main methods of connecting centrifugal pumps (D):

15. Adjust the flow of a constant-speed pump by installing a valve at the outlet so as to create a variable restriction.
16. Determine the flow of a liquid circulating in a simple installation using a U-manometer, a venturi and the pressure/flow chart.
17. Establish the relationship between the flow and the pressure of a liquid conveyed by a pump.
18. Plot, on graph paper, the curve representing the pressure/flow relationship in a centrifugal pump in operation.
19. Define "power" and "efficiency."
20. Determine the variables that influence the operating conditions of a centrifugal pump.
21. Calculate the "available" and "required" absolute net charges.

MODULE 26: HUMIDIFIERS

CODE: 800 331 **Duration: 15 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
identify the characteristics and use of humidifiers
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Following instructions
- Using a real humidifier or a graphical representation
- Without using technical documentation

GENERAL PERFORMANCE CRITERIA

- Accurate description of the main humidification processes
- Accurate description of the main characteristics of the construction and use of various humidifiers
- Description of the main methods of maintaining humidifiers
- Use of appropriate terminology

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Describe the main water vaporization processes of the air in a building.	- Appropriate description of processes: • identification of process • stages • advantages and disadvantages
B. Describe the operating principle of humidifiers.	- Accurate description of: • types of humidifiers • mechanical parts • electrical parts
C. Describe the characteristics of the installation of humidifiers.	- Appropriate description of criteria for selecting: • a humidifier • the location of the humidifier - Appropriate description of: • the necessary tools and materials • procedures for testing and checking components • installation techniques • electrical connections • mechanical connections
D. Describe the maintenance procedure for humidifiers.	- Appropriate description of techniques: • checking the humidifier • replacing components • cleaning the humidifier • treating the water

FIELD OF APPLICATION

- Refrigeration and air conditioning
- Main types of humidifiers: steam (external source), vaporizing (drum type), atomizing, etc.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to describe the main water vaporization processes of the air in a building (A):

1. Calculate the relative humidity resulting from different mixtures of fresh air and return air from an air conditioning system.
2. Calculate the quantity of water needed to increase the humidity level in a room or building.

Before learning how to describe the operating principle of humidifiers (B):

3. Identify the types of humidifiers.
4. Indicate the factors necessary for the effective operation of a humidifier.
5. Describe the mode of operation of the water flow controls.
6. Justify the quality of the water used in humidifiers.

Before learning how to describe the characteristics of the installation of humidifiers (C):

7. Describe the method of installing humidifiers.
8. Justify the precautions to be taken when determining the location for a humidifier.
9. Describe the connections required to install a humidifier.
10. Describe the mode of operation of the humidistats.

Before learning how to describe the maintenance procedure for humidifiers (D):

11. Describe the methods and techniques for cleaning humidifiers.
12. Check and adjust the humidistats.
13. Select and add chemicals to the water in a humidifier.
14. Carry out the required tests related to the operation of a humidifier.

MODULE 27: LOAD CALCULATIONS

CODE: 800 343 **Duration: 45 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
carry out an energy analysis of a refrigeration system
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Energy analysis based on hypothetical situations (operating conditions of the system)
- Using calculation tables
- Using a calculator and other necessary instruments
- Using the appropriate documentation

GENERAL PERFORMANCE CRITERIA

- Accurate calculations of heat lost and gained by the system
- Appropriate selection of system components according to the required energy load
- Mastery of techniques for using measuring instruments
- Mastery of techniques for checking the efficiency of a system
- Accurate calculation of the efficiency rating of a system

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Calculate the cooling load of a refrigeration system.	- Accurate explanation of heat transfer phenomena - Accurate definitions - Appropriate use of specialized tables - Accurate calculations of: • gain obtained through conduction • gain due to stored products • gain due to air infiltration • gain due to equipment • gain due to people • safety factor • total gain • operating time • capacity schedule
B. Use short method calculation to compare the cooling load of a refrigeration system in operation with the capacity of its components.	- Appropriate use of manufacturers' tables - Accurate assessment of the differences between the cooling load of the system and the capacity of its components: • evaporator • compressor • expansion valve • piping
C. Check the relationship between the capacity of the components and the cooling load of an air conditioning system.	- Appropriate use of manufacturers' tables - Accurate assessment of the differences between the energy charge of the system and the capacity of its components: • compressor • condenser • evaporator • expansion valve • piping

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
D. Check the cooling capacity of a residential air conditioner.	- Appropriate choice of verification technique - Mastery of verification techniques - Accurate assessment of the system's capacity
E. Determine the heat rejection at the condenser of a refrigeration system.	- Appropriate selection of assessment method - Accurate assessment
F. Explain how the efficiency of a refrigeration system can be changed.	- Accurate description of all the factors that can change the efficiency of a system - Logical explanations

FIELD OF APPLICATION

- Refrigeration and air conditioning
- Energy analysis of all commonly used refrigeration and air conditioning systems

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to calculate the cooling load of a refrigeration system (A):

1. Perform simple calculations to determine the cooling load produced by the products in a walk-in refrigerator.
2. Describe the phenomenon of heat transfer through a homogenous wall.
3. Define "thermal conductivity" (k).
4. Define "thermal conductance" (C).
5. Define "thermal resistance" (R).
6. Define "total heat transformer rate" (U).
7. Explain the phenomenon of heat transformer rates for different surfaces (air film).
8. Calculate the thermal resistance (R) of a multi-unit wall and its total heat transformer rate (U).
9. Calculate the heat transfer through a multi-unit wall, using Fourrier's theorem.
10. Perform simple calculations to determine the cooling load produced by heat transfer through the walls of a walk-in refrigerator.
11. Explain how a walk-in refrigerator is affected by the infiltration of air that results from opening the doors.
12. Perform simple calculations to determine the cooling load produced by air infiltration in a walk-in refrigerator.
13. Perform simple calculations to determine the cooling load produced by equipment and people in a walk-in refrigerator.

Before learning how to use short method calculation to compare the cooling load of a refrigeration system in operation with the capacity of its components (B):

14. Calculate the heat gain due to heat transfer through the walls of a walk-in refrigerator, using short method calculation (e.g. Dunham Bush).
15. Calculate, at the same time, heat gain due to air infiltration, products stored, equipment and people, using short method calculation (e.g. Dunham Bush).
16. Gather all the information available on the refrigeration system in question.
17. Establish a verification procedure for the refrigeration system in question.
18. Check the refrigeration system in question.
19. Gather the information required for making comparisons.
20. Compare the actual cooling load with the cooling load provided for in the project design.
21. Assess the capacity of each component of the system in question.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to check the relationship between the capacity of the components and the cooling load of an air conditioning system (C):

22. Consult the plans and specifications of the air conditioning system in operation in order to compare the cooling load provided for in the project design with the actual cooling load of the system.
23. Check the air conditioning system in question.
24. Assess the capacity of each component of the air conditioning system in question.

Before learning how to check the cooling capacity of a residential air conditioner (D) and to determine the heat rejection at the condenser of a refrigeration system (E):

25. Gather the written documentation available on the refrigeration system in question.
26. Check the operation of the refrigeration system in question.
27. Calculate the maximum and minimum charge of an evaporator.

Before learning how to explain how the efficiency of a refrigeration system can be changed (D):

28. Recognize the factors that can affect the efficiency of an evaporator.
29. Recognize the factors that can affect the efficiency of a condenser.
30. Recognize the factors that can increase the cooling load of a walk-in refrigerator.
31. Recognize the factors that can affect the flow of the refrigerant in the pipes.

MODULE 28: COMPRESSORS

CODE: 800 312 **Duration: 30 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
describe the techniques for installing compressors and check their operation
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Given hypothetical situations
- Following instructions
- Without using technical documentation

GENERAL PERFORMANCE CRITERIA

- Appropriate description of the characteristics of the construction, operation and use of compressors
- Accurate description of installation techniques
- Mastery of method of checking a compressor
- Accurate assessment of the operating condition of the compressor
- Use of appropriate English and French terminology

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Describe the characteristics of the construction and operation of compressors.	- Complete list of characteristics - Appropriate description of characteristics: • type of housing • method of volume displacement • type of drive • lubrication • cooling • circulation of refrigerant (flowchart)
B. Describe the operating characteristics of various capacity control devices on compressors.	- Appropriate description of: • operating principles • mechanism • possible uses
C. Select compressors.	- Appropriate use of catalogues - Appropriate selection according to: • characteristics of the compressor • operating conditions
D. Describe the techniques for installing compressors.	- Accurate description of techniques: • single installation • multiple installation

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
E. Check the operating condition of a compressor.	- Mastery of verification techniques: • level and quality of oil • pumping capacity • leakproof system • operating condition of capacity regulator - Accurate assessment of the operating condition of the compressor - Appropriate recommendations concerning preventive maintenance and repairs

FIELD OF APPLICATION

- Refrigeration and air conditioning
- All compressors used in refrigeration and air conditioning

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to describe the characteristics of the construction and operation of compressors (A):

1. Locate the compressor in a system.
2. Identify the types of compressors.
3. Describe the characteristics of the construction and operation of compression mechanisms.
4. Describe the methods of lubricating compressors.
5. Explain the types of compressor drives.
6. List the main cooling methods of compressors.
7. List the construction factors that determine the volume of vapour displaced by a compressor.
8. Calculate the volume displacement of a reciprocating compressor.
9. Describe the operating factors that determine actual volume displacement.
10. Calculate the volumetric efficiency of a compressor in a given system.

Before learning how to describe the operating characteristics of various capacity control devices on compressors (B):

11. List the capacity reducing devices on compressors.
12. Recognize the capacity control devices of compressors and their components.

Before learning how to select compressors (C):

13. Describe the characteristics of a refrigeration system.
14. Determine the utilities required to install a refrigeration system.

Before learning how to describe the techniques for installing compressors (D):

15. List the materials and tools needed to install a compressor.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to check the operating condition of a compressor (E):

16. Make the verifications related to the lubrication of a compressor.
17. Change the oil in a compressor.
18. Make mechanical verifications of a compressor.
19. Make electrical verifications of a compressor.
20. Establish methods for shutting down and starting up a compressor.

MODULE 29: CONTROLLERS AND CONTROL SOFTWARE

CODE: 800 356 **Duration: 90 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
use preventive maintenance and master control software
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Following the teacher's instructions
- Given hypothetical situations in which they must use controls related to the programming of a piece of equipment, the modification of instructions, and so on
- Using all the necessary materials and equipment (e.g. controller, programmable controller)
- Using all the necessary documentation
- Observing time limits

GENERAL PERFORMANCE CRITERIA

- Understanding of the operation of the computer and software used
- Proper use of the various controls
- Achievement of desired results

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Start up a microcomputer and use the basic file commands: • load • save • copy • delete • check	- Correct start-up and shut-down of computer and peripherals - Selection of appropriate command according to desired result - Safe use of file commands
B. Interpret different operating sequences for programmable controllers on the basis of: • a stable state control diagram • a ladder diagram • a literal diagram • the computer listing • connection diagrams	- Observance of procedures for naming diagrams (stable state control, ladder, literal) - Accurate explanation of the role of input variables in programming - Accurate description of the effect of an output on the operation of a component - Accurate interpretation of connection diagrams for components outside the controller - Accurate explanation of the role of the controller with regard to various parts of the system
C. Read and interpret data (temperatures, pressure, operating conditions), using: • a programmed controller dedicated to a refrigeration system • a programmable controller dedicated to a central ventilation and air conditioning system	- Mastery of various techniques for accessing system variables: • menu • key word • code - Accurate data - Appropriate interpretation of data gathered: • comparison with established standards • detection of problems

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
D. Perform operations and modify operating parameters on a programmable controller and a programmed controller.	- Appropriate selection of function (e.g. start-up, shut-down) - Observance of procedures for modifying parameters or instructions - Accurate description of the effect of the modification of a function or instruction on the system
E. Troubleshoot a building mechanics system connected to: • a programmable controller • a programmed controller	- Accurate assessment of source of problem: • internal (controller) • external (system) - Observance of verification sequence - Appropriate diagnoses - Choice of appropriate corrective measure - System operational
F. Run the various specialized control software programs: • schedule programming • reports • load monitoring • optimal up time • graphics	- Appropriate inscription of the various modifiable parameters of the program: • time, date • limits • frequency - Program operational: • start-up and shut-down at fixed times • load monitoring according to established priorities • printout of reports (status, alarm, trend) • use of graphics functions

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to start up a microcomputer and use the basic file commands:

- **load**
- **save**
- **copy**
- **delete**
- **check (A):**

1. Trace the history of the development of control systems.
2. Describe the various functions performed by control systems in the building mechanics sector.
3. Compare the applications of controllers with those of programmable controllers.
4. Describe the components of a computer and its peripherals.
5. Recognize the physical aspects of a microcomputer and its peripherals.
6. Recognize the function of the main keyboard keys.
7. Describe the types of computer operating systems and their role.
8. Identify the different ways of identifying and indexing files.
9. Describe the characteristics of diskettes and the preventive measures to be taken when handling them.
10. Identify the main software programs used in building mechanics management.

Before learning how to interpret different operating sequences for programmable controllers on the basis of:

- **a stable state control diagram**
- **a ladder diagram**
- **a literal diagram**
- **the computer listing**
- **connection diagrams (B):**

11. List the advantages and the disadvantages of using programmable controllers as opposed to conventional relay controls.
12. Identify the three main programming languages and their related controller models.
13. Draw a conventional relay diagram of an elementary start-stop circuit.
14. Give the same information in a ladder diagram.
15. Draw the connection diagram of the inputs and outputs and connect the input-output devices.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

16. Load the ladder program in the controller and test the actual circuit.
17. Reedit the basic relay diagram in *grafcet*.
18. Translate the *grafcet* program into ladder language.
19. Translate the basic relay diagram into literal language.
20. Compare the strengths and weaknesses of the *grafcet*, ladder and literal languages.

Before learning how to read and interpret data (temperatures, pressure, operating conditions), using:

- **a programmed controller dedicated to a refrigeration system**
- **a programmable controller dedicated to a central ventilation and air conditioning system (C):**

21. Explain the respective advantages of the centralization and decentralization of data and control within one or more buildings.
22. Produce basic architectural drawings of centralized, distributed and mixed intelligence automation systems.
23. List the types of products available.
24. Explain the role of the personal security code when starting up the program.

Before learning how to perform operations and modify operating parameters on a programmable controller and a programmed controller (D):

25. Determine the uncontrollable variables that can affect the operation of building mechanics systems.
26. Recognize the parameters that can be modified by uncontrollable variables.
27. Explain why certain variables cannot be modified.

Before learning how to troubleshoot a building mechanics system connected to:

- **a programmable controller**
- **a programmed controller (E):**

28. Describe the main causes of malfunction of controllers and programmable controllers.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to run the various specialized control software programs:

- **schedule programming**
- **reports**
- **load monitoring**
- **optimal up time**
- **graphics (F):**

29. Identify the main functions commonly attributed to special applications software.
30. Describe the basic characteristics common to most applications software.
31. Identify the characteristics specific to schedule programming and up time recording software.
32. Describe the function of alarm annunciators and status accounting programs.
33. Identify the general characteristics of power management and load monitoring software.
34. Describe the types of reports available in a control software program.
35. Explain the function of other software programs with specific applications.

MODULE 30: CHILLER MAINTENANCE

CODE: 800 373 **Duration: 45 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
ensure that a chiller is functioning correctly
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Given hypothetical situations
- Following instructions (theory)
- Theoretical work related to the description of operating principles
- Theoretical work related to problem solving
- Using the necessary plans and technical documentation

GENERAL PERFORMANCE CRITERIA

- Accurate description of the mode of operation of the chiller system
- Appropriate description of the method of maintaining a chiller
- Mastery of techniques for analyzing the chiller system
- Accurate diagnoses and appropriate recommended corrections
- Mastery of techniques for repairing and starting up the chiller system
- System operating in accordance with manufacturer's standards
- Observance of health and safety rules
- Observance of time limits

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Identify the characteristics of the construction and operation of chillers.	- Accurate comparison of: • refrigerant • main components • method of installation • required utilities • capacity
B. Determine the technique for checking a chiller for maintenance purposes.	- Complete list of check points - Accurate description of verification procedures and work required at each point - Accurate description of verifications and work required in fall and spring on chillers installed in central air conditioning systems
C. Analyze an operational problem affecting the system.	- Logical sequence of operations - No unnecessary checks
D. Diagnose the problem and indicate the corrections to be made to the system.	- Accurate diagnosis - Appropriate corrections
E. Make the corrections to the system.	- Mastery of techniques for repairing components: • choice of replacement parts • removal and installation of parts • disassembly and assembly of parts

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
F. Start up the system.	- Mastery of techniques for starting up the system: • efficiency tests • control sequence • voltage and current • operating pressure • operating temperature • liquid flow - Observance of manufacturer's standards

FIELD OF APPLICATION

- Refrigeration and air conditioning
- Mainly repair of chillers connected to central air conditioning systems

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to identify the characteristics of the construction and operation of chillers (A):

1. Identify the different types of chillers.
2. Be familiar with the components of a chiller.
3. Describe the flow of the refrigerant in a chiller.
4. Describe the flow of chilled water in a chiller.
5. Describe the flow of condensed water in a chiller.
6. Explain the mode of operation of the components of the refrigerating circuit of a chiller with a centrifugal compressor.
7. Be familiar with and explain the mode of operation of the electrical components of a chiller.

Before learning how to determine the technique for checking a chiller for maintenance purposes (B):

8. Describe the mode of operation of a chiller (available in the workshop).
9. Describe the methods of checking the quality of the water in a chiller.
10. Select a device for measuring the quality of the water in a chiller.
11. Assess the quality of the water or other liquids using an appropriate device.
12. Treat the water so that it meets the recommended standards.
13. Be familiar with the main points to be checked for the preventive maintenance of a chiller.
14. Check the electrical circuit of a chiller.
15. Check the refrigerating circuit of a chiller.
16. Check the ice water circuit of a chiller.

Before learning how to analyze an operational problem affecting the system (C):

17. Check the operation of a chiller.
18. Describe, in general terms, the signs of a malfunction.
19. Describe, in general terms, the causes of a malfunction.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to diagnose the problem and indicate the corrections to be made to the system (D):

20. Locate the subsystem likely to be the cause of the problem.
21. Gather the information necessary for analyzing the subsystem likely to be the cause of the problem.

Before learning how to make the corrections to the system (E):

22. Check the components of the subsystem likely to be the cause of the problem.
23. Determine the steps involved in solving the problem.
24. Explain the main reasons why a control system is used on chillers.
25. Identify the types of controls used on chillers.
26. Explain the methods of adjusting the controls used on chillers.
27. Recognize the effects of water in the pipes.
28. Recognize the deposits likely to reduce the flow of water in the pipes and fittings.
29. Determine the piping and components to be cleaned.
30. Recognize the types of evaporators used in chillers.
31. Recognize and select methods of cleaning the components to eliminate the effects of the water.

Before learning how to start up the system (F):

32. Describe the techniques for starting up a chiller.
33. Carry out various tests on a chiller after correcting an operational problem.

MODULE 31: CENTRAL AIR CONDITIONING SYSTEMS

CODE: 800 388 **Duration: 120 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
ensure that a central air conditioning system is functioning correctly
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Given a hypothetical situation
- Using plans of a system including technical information on its operation
- Using the necessary technical documentation

GENERAL PERFORMANCE CRITERIA

- Appropriate description of characteristics of the subsystems and the central system
- Accurate explanation of the operating principles of each subsystem
- Mastery of basic techniques for detecting a breakdown
- Mastery of basic techniques for calibrating a ventilation system and adjusting the automatic devices
- Appropriate preparation of reports and technical sheets
- Quality work:
  - accurate diagnosis
  - appropriate solutions
  - accurate adjustments
- Observance of health and safety rules
- Observance of time limits

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Interpret the plan of the system.	- Accurate indication of: • components • accessories • lines
B. Describe the operating principle of the central system and the subsystems.	- Accurate description of the operating sequence of each subsystem
C. Adjust the position or the operation of the system or parts of the system.	- Appropriate method of adjusting and regulating the system - Appropriate use of tools and measuring instruments - System operating in accordance with specifications
D. Recognize the causes of operational problems affecting the central system.	- Appropriate verification method - Proper use of measuring instruments: • handling • reading • adjusting - Accurate description of the nature of the breakdown - Recognition of cause(s)
E. Establish a maintenance schedule for the system.	- Detailed and feasible schedule: • identification of components • elements to be checked • required maintenance operations • timetable

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR

F. Prepare a report on work done or to be done.

SPECIFIC PERFORMANCE CRITERIA

- Inclusion of:
  - identification of defective equipment
  - particular characteristics of equipment
  - necessary readings or measurements
  - nature of problems
  - recommendations
  - description of repairs
  - cost assessment

FIELD OF APPLICATION

- Refrigeration and air conditioning
- Central air conditioning systems

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to interpret the plan of the system (A):

1. Interpret the legend of a plan.
2. Select, from a set of plans, the plans representing a central air conditioning system.
3. Interpret the symbols shown on the plan of a central air conditioning system.

Before learning how to describe the operating principle of the central system and the subsystems (B):

4. Locate, on an actual installation, all the subsystems and components of a central air conditioning system.
5. Describe the mode of operation of the ventilation subsystem.
6. Describe the mode of operation of the air conditioning subsystem.
7. Describe the mode of operation of the refrigeration subsystem.
8. Describe the mode of operation of the heating subsystem.
9. Describe the mode of operation of the control subsystem.
10. Describe the mode of operation of the humidification subsystem.

Before learning how to adjust the position or the operation of the system or parts of the system (C):

11. Be familiar with and explain the method of using the measuring instruments required for the air circuit.
12. Select measuring instruments for pressure, velocity and air flow.
13. Represent, on a psychrometric chart, the operation of the analyzed system.
14. Indicate the uncontrollable variables that can affect the operation of a central air conditioning system.
15. Indicate the parameters changed by the uncontrollable variables.
16. Determine the means of controlling the air distribution on a central air conditioning system.
17. Explain the operating logic of the electrical motor and accessory controls.
18. Explain the operating logic of the sensors, louvres and accessories of the pneumatic circuit.
19. Take readings to assess the refrigerating capacity of the central system.
20. Compare the recorded values (e.g. air flow, temperature) with the expected values.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

21. Check the operation of the air circuit of a central system.
22. Check the operation of the refrigerating circuit of a central air conditioning system.
23. Check the overall operation of the system through the thermostats.
24. Describe the changes to be made to the system in accordance with the observed and expected operating conditions.

Before learning how to recognize the causes of operational problems affecting the central system (D):

25. Check the operation of an air conditioning system that needs repairing.
26. Give a brief description of the possible signs of operational problems.
27. Give a brief description of the possible causes of operational problems.
28. Analyze an operational problem in order to solve it.

Before learning how to establish a maintenance schedule for the system (E):

29. Be familiar with the components of a central system that require periodic maintenance checks (i.e. more than twice per year) and describe the required procedures.
30. Describe all the verifications to be made on a central air conditioning system.
31. Describe all the verifications to be made on a central air conditioning system before the air conditioning season.
32. Describe all the verifications to be made on a central air conditioning system before the heating season.

Before learning how to prepare a service report on work done or to be done (F):

33. Assess the time required to repair and maintain components of a central air conditioning system.
34. Research the cost of replacement parts.

MODULE 32: JOB SEARCH TECHNIQUES

CODE: 800 292 **Duration: 30 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
apply job search techniques
in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- After confirming their career choice
- Focusing on existing or possible jobs in the fields of refrigeration and air conditioning
- Referring to a written self-assessment

GENERAL PERFORMANCE CRITERIA

- Coherent and realistic job search plan
- Quality résumé
- Clear letter of introduction
- Appropriate description of job search and interview techniques

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Prepare a résumé and a letter of introduction.	- Quality presentation - Inclusion of: • work experience • training and skills • personal information • activities - Content relevant to job being applied for and nature of letter: • response to a job advertisement • unsolicited job application • accompanying a résumé - No errors - Clarity
B. Plan the job search in writing.	- Appropriate steps listed - Logical sequence of steps
C. Match each step in the plan to a selected procedure.	- Appropriate procedure selected on the basis of the following questions: • what • who • when • where
D. Assess the feasibility of the job search plan.	- Accurate assessment - Reasons cited to justify assessment
E. Plan a job search.	- Coherent, realistic procedure - Appropriate steps

FIELD OF APPLICATION

- Companies in the fields of refrigeration and air conditioning

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to prepare a résumé and a letter of introduction (A):

1. Define the elements of a self-assessment.
2. Describe their background, education and work experience.
3. State the knowledge they have acquired through their background, education and work experience.
4. State the skills they have developed through their background, education and work experience.
5. Recognize their personality traits.
6. Prepare a self-assessment.
7. Describe their outlook on the future and the values underlying their career choice.
8. Locate one or more jobs that correspond to their interests and values by referring to job descriptions.
9. Describe the requirements of the jobs they have chosen.
10. Compare these requirements with the strengths and weaknesses listed in their self-assessment.
11. Assess the implication of their choices.
12. Explain how job market conditions can affect their chances of obtaining a job.
13. Explain how certain attitudes, behaviours and qualities can help or hinder their integration into the work force.
14. Define the attitudes to be adopted for a positive job search.
15. Describe job search techniques.
16. Describe types of résumés and letters of introduction.

Before learning how to plan the job search in writing (B):

17. Identify the characteristics of an interview.
18. Become aware of the importance of certain attitudes and behaviours in an interview.
19. Participate in a selection interview.
20. Assess a selection interview.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to match each step in the plan to a selected procedure (C), to assess the feasibility of the job search plan (D) and to plan a job search (E):

21. Begin a supervised job search.

MODULE 33: CONSTRUCTION ORGANIZATIONS

CODE: 755 001 **Duration: 15 hours**

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

EXPECTED OUTCOME

By participating in the required activities of the learning context according to the indicated criteria, the students will be able to
learn about the organizations in the construction industry.

SPECIFICATIONS

During this module, the students will:

- Identify the main roles and responsibilities of employer and union organizations and associations:
  - describe the construction industry, its characteristics and its economic importance
  - name the employer associations and identify their roles and responsibilities
  - name the representative union associations and identify their roles and responsibilities
  - list the main functions of the Commissaire de la construction, the Conseil d'arbitrage and the Régie des entreprises de construction du Québec
  - describe the structure and composition of the Commission de la construction du Québec (CCQ) and be familiar with its main functions
  - list the powers of the CCQ and the provisions regarding violation of the *Act respecting labour relations, vocational training and manpower management in the construction industry* or related regulations
- Describe the laws and regulations governing labour relations in the construction industry:
  - be familiar with the *Act respecting labour relations, vocational training and manpower management in the construction industry* and its field of application
  - be familiar with the labour relations and the laws and regulations related to the construction industry

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

SPECIFICATIONS (cont.)

- describe the provisions of *An Act respecting manpower vocational training and qualification*
- describe the main provisions of *An Act respecting complementary social benefits plans in the construction industry*

LEARNING CONTEXT

PHASE 1: **Information**

- Becoming familiar with the objective of the unit and companion guide.

PHASE 2: **Learning**

- Gathering information on the topic covered.

- Expressing opinions on the topic covered and asking questions.

PHASE 3: **Reinforcement**

- Reviewing the main concepts of the unit.

- Answering a series of questions individually.

- Correcting the answers in a group.

INSTRUCTIONAL GUIDELINES

The teacher should:

- Ensure access to a suitable room and proper materials.
- Present the material in an interesting manner.
- Encourage students to participate in group discussions.
- Use charts and illustrations.

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

PARTICIPATION CRITERIA

- Participate in seven of the nine units.
- Listen attentively.
- Stick to the topic during discussions.
- Adopt appropriate behaviour.
- Ask pertinent questions and give appropriate answers.
- Do the exercises conscientiously.
- Correct any errors.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before undertaking the activities of Phase 1:

1. Be receptive to related information.
2. Be willing to share their knowledge with the other members of the group.

Before undertaking the activities of Phase 2:

3. Explain the main rules governing group discussion.

Before undertaking the activities of Phase 3:

4. Describe the method of answering a series of questions.

REFRIGERATION (5575)

800 012	TRADE & TRAINING PROCESS TO DETERMINE THEIR SUITABILITY FOR THE TRADE AND THE TRAINING PROCESS
800 024	REFRIGERATION CYCLE THEORY TO EXPLAIN THE VAPOUR-COMPRESSION CYCLE
800 036	MAINTENANCE EQUIP & MECHANICS TO PERFORM BASIC MECHANICAL MAINTENANCE TASKS
800 042	CUTTING, WELDING & BRAZING TO PERFORM OXYACETYLENE-CUTTING, WELDING AND BRAZING OPERATIONS
800 053	RECOVERING REFRIGERANTS TO PERFORM TASKS RELATED TO THE REDUCTION AND RECOVERY OF CHLOROFLUOROCARBON (CFC) EMISSIONS
800 063	METERING DEVICES TO INSTALL AND ADJUST METERING DEVICES
800 071	CONDENSERS AND EVAPORATORS TO IDENTIFY THE CHARACTERISTICS OF THE CONSTRUCTION, OPERATION AND USE OF EVAPORATORS AND CONDENSERS
800 104	GENERAL ELECTRICITY TO APPLY THE BASIC ELECTRICAL PRINCIPLES AND TECHNIQUES
800 095	BASIC REFRIGERATING CIRCUITS TO ASSEMBLE A BASIC REFRIGERATING CIRCUIT

800 082	RECIPROCATING COMPRESSORS	
	TO ENSURE THAT A RECIPROCATING COMPRESSOR IS FUNCTIONING CORRECTLY	
800 112	DIAGRAMS AND SKETCHES	
	TO DRAW DIAGRAMS OF COMPONENTS AND CIRCUITS	
800 128	MOTOR CIRCUITS & CONTROL ASS.	
	TO INSTALL A MOTOR CIRCUIT AND ITS ELECTRICAL CONTROL ASSEMBLY, AND ENSURE THAT THEY FUNCTION CORRECTLY	
800 143	REFRIGERATION SYSTEM PIPING	
	TO INSTALL THE PIPING FOR A REFRIGERATION OR AIR CONDITIONING SYSTEM	
800 158	WALK-IN REFRIGERATORS	
	TO PERFORM TASKS RELATED TO THE INSTALLATION OF A WALK-IN REFRIGERATOR	
800 232	HEAT EXCHANGERS	
	TO IDENTIFY THE CHARACTERISTICS OF THE CONSTRUCTION, OPERATION AND USE OF HEAT EXCHANGERS	
800 243	ELECTRONIC CONTROL CIRCUITS	
	TO CHECK THE OPERATION OF AN ELECTRONIC CONTROL CIRCUIT	
755 002	CONSTRUCTION HEALTH & SAFETY	
	TO APPLY CONCEPTS RELATED TO HEALTH AND SAFETY ON CONSTRUCTION SITES	
800 134	FLUID SYSTEM REGULATORS & ACC.	
	TO ENSURE THAT THE FLUID SYSTEM REGULATORS AND ACCESSORIES ARE FUNCTIONING CORRECTLY	

800 164	REFRIGERATED DISPLAY CASES
	TO ENSURE THAT A REFRIGERATED DISPLAY CASE IS FUNCTIONING CORRECTLY
800 226	VENTILATION & AIR CONDITIONING
	TO ANALYZE VARIOUS VENTILATION AND AIR CONDITIONING PROCESSES
800 264	SELF-CONTAINED AIR CONDITIONERS
	TO ENSURE THAT A SELF-CONTAINED AIR CONDITIONING UNIT IS FUNCTIONING CORRECTLY
800 277	INSTALL SPLIT-SYSTEM HEAT PUMPS
	TO PERFORM TASKS RELATED TO THE INSTALLATION OF A UNITARY OR ADD-ON SPLIT-SYSTEM HEAT PUMP
800 365	MAINTAINING HEAT PUMPS
	TO ENSURE THAT A HEAT PUMP IS FUNCTIONING CORRECTLY
800 252	PLANS AND SPECIFICATIONS
	TO READ AND INTERPRET PLANS AND SPECIFICATIONS
800 322	CENTRIFUGAL PUMPS
	TO DESCRIBE AND CHECK THE OPERATION OF CENTRIFUGAL PUMPS
800 331	HUMIDIFIERS
	TO IDENTIFY THE CHARACTERISTICS AND USE OF HUMIDIFIERS
800 343	LOAD CALCULATIONS
	TO CARRY OUT AN ENERGY ANALYSIS OF A REFRIGERATION SYSTEM
800 312	COMPRESSORS
	TO DESCRIBE THE TECHNIQUES FOR INSTALLING COMPRESSORS AND CHECK THEIR OPERATION

800 356	CONTROLLERS & CONT. SOFTWARE	
	TO USE PREVENTIVE MAINTENANCE AND MASTER CONTROL SOFTWARE	
800 373	CHILLER MAINTENANCE	
	TO ENSURE THAT A CHILLER IS FUNCTIONING CORRECTLY	
800 388	CENTRAL AIR CONDITIONING SYS.	
	TO ENSURE THAT A CENTRAL AIR CONDITIONING SYSTEM IS FUNCTIONING CORRECTLY	
800 292	JOB SEARCH TECHNIQUES	
	TO APPLY JOB SEARCH TECHNIQUES	
755 001	CONSTRUCTION ORGANIZATIONS	
	TO LEARN ABOUT THE ORGANIZATIONS IN THE CONSTRUCTION INDUSTRY	

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