

# Apprenticeship and Industry Training

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## Refrigeration and Air Conditioning Mechanic Curriculum Guide

014 (2022)

Alberta 



Apprenticeship  
and Industry  
Training

**ALBERTA ADVANCED EDUCATION**

Refrigeration and Air Conditioning Mechanic: apprenticeship education program curriculum guide

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# Refrigeration and Air Conditioning Mechanic

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## Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding a sponsor. Sponsors guide apprentices, and support on-the-job learning through provision of mentorship. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyperson or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution (PSI) – usually a college or technical institute.

To receive their postsecondary credential, apprentices must learn theory and skills, and they must pass examinations. Criteria for the program—including the content and delivery of technical training—are developed and updated by the Registrar.

The graduate of the Refrigeration and Air Conditioning Mechanic apprenticeship training is an individual who will be able to:

- supervise, train and coach apprentices
- use and maintain hand and power tools to the standards of competency and safety required in the trade
- have a thorough knowledge of the principle components of refrigeration systems, heat/cool units and air conditioning
- have a thorough knowledge of the electrical and automatic controls used in all aspects of the refrigeration and air conditioning industry
- be capable of assembling, installing or overhauling all components
- have an intimate knowledge of other mechanical trades, which contribute to refrigeration and air conditioning systems
- be proficient in the use of test instruments
- exercise good judgment and resourcefulness in construction, maintenance and workplace health and safety
- know, and be able to apply their knowledge of the installation, and service of HVAC systems in accordance with local, provincial and national standards for the industry
- do all Refrigeration and Air Conditioning Mechanic tasks expected of someone who carries this credential.

### Apprenticeship and Industry Training System

Alberta's apprenticeship programs are supported by industry stakeholders that ensures a highly skilled, internationally competitive workforce in the province. The Registrar establishes the educational standards and provides direction to the system supported by industry and the PSI's. The Ministry of Advanced Education provides the legislative framework and administrative support for the apprenticeship and industry training system.

**Special thanks are offered to the following industry members who contributed to the development of the standard:**

Mr. Aaron Mathes..... Fort McMurray  
Mr. George Bird..... Calgary  
Mr. David Malay ..... Edmonton  
Mr. Aubrey Hilman..... Calgary  
Mr. David Rice..... St. Albert  
Mr. Rene Lauenstein ..... Calgary  
Mr. Michael Whiting..... Lethbridge  
Mr. Koi Sim Wong ..... Calgary

### Alberta Government

Alberta Advanced Education works with industry, sponsor and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and sponsors
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

## **Apprentice Safety**

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, sponsors, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

### **Occupational Health and Safety**

Persons engaged in, or supporting an individual in an experiential learning environment are often exposed to more worksite hazards than in other forms of traditional post-secondary education and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Occupational Health and Safety-OHS (a division of Alberta Labour and Immigration) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at [www.alberta.ca/occupational-health-safety.aspx](http://www.alberta.ca/occupational-health-safety.aspx)

### **Technical Training**

Apprenticeship technical training is delivered by the PSI's throughout Alberta. The PSI's are committed to delivering the technical training component of Alberta apprenticeship education programs in a safe, efficient and effective manner. All PSI's place a strong emphasis on safety that complements safe workplace practices towards the development of a culture of safety for all professions.

The PSI's work with industry and Alberta Advanced Education to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship education programs across the province. They develop curriculum from the curriculum guides established by the Registrar in consultation with the PSI's and industry and provide the technical training to apprentices.

The following institutions deliver Refrigeration and Air Conditioning Mechanic trade apprenticeship technical training:

Northern Alberta Institute of Technology  
Southern Alberta Institute of Technology

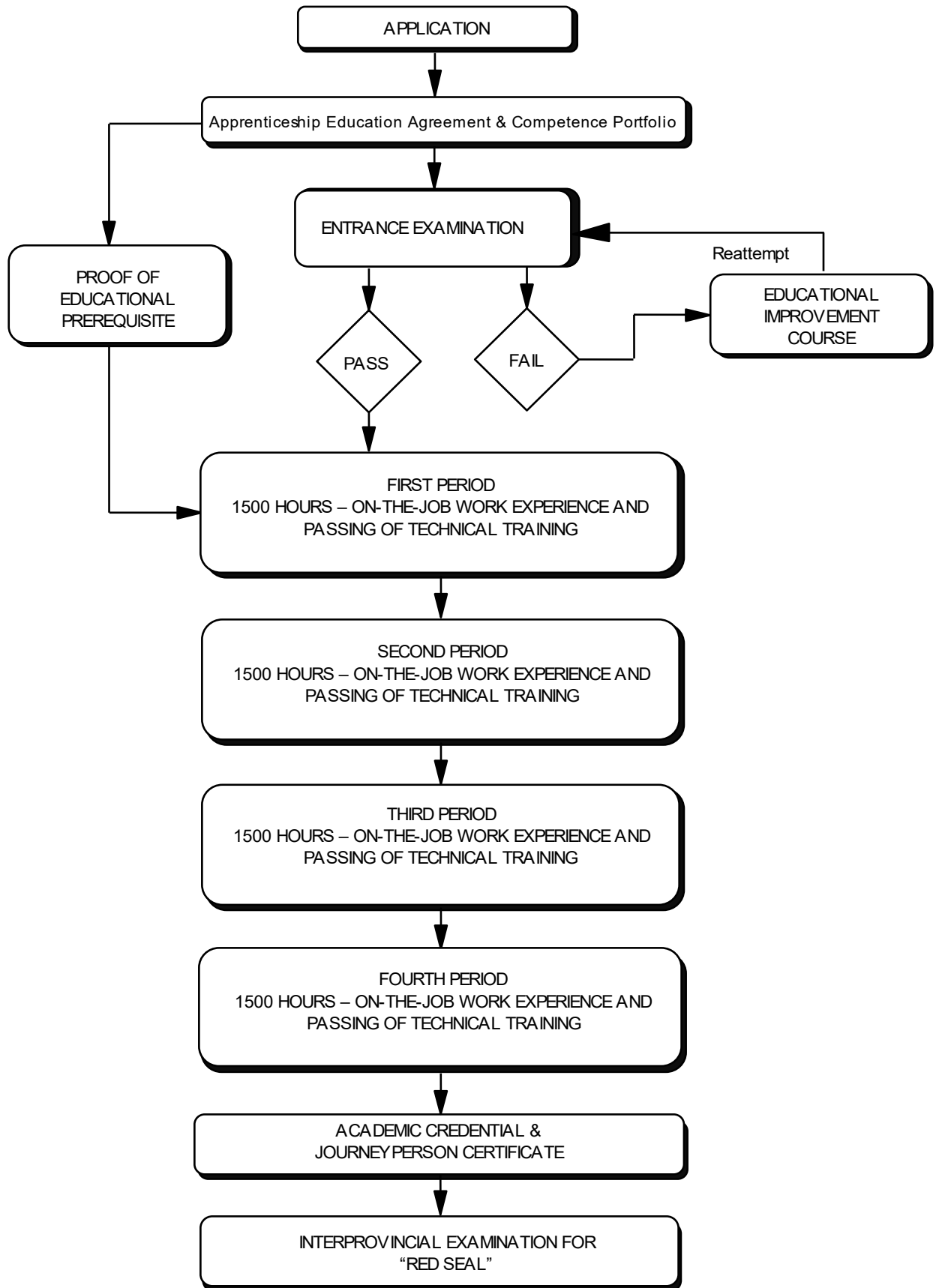
### **Procedures for Recommending Revisions to the Curriculum Guide**

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

Registrar of Apprenticeship Education Programs  
c/o Apprenticeship Delivery and Industry Support Services  
Apprenticeship Delivery and Industry Support  
Advanced Education  
19th floor, Commerce Place  
10155 102 Street NW  
Edmonton AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used.

### Apprenticeship Route toward Academic Credential



## Refrigeration and Air Conditioning Mechanic Training Profile

### FIRST PERIOD

(8 Weeks 30 Hours per Week – Total of 240 Hours)

#### SECTION ONE

<b>OCCUPATIONAL SKILLS</b>  25%	<b>A</b>	<b>B</b>	<b>C</b>
	Safety Legislation, Regulations & Industry Policy in the Trades 3%	Climbing, Lifting, Rigging and Hoisting 2%	Hazardous Materials & Fire Protection 5%
	<b>D</b>	<b>E</b>	<b>F</b>
	Apprenticeship Training Program 3%	Tools and Instruments 13%	Ladders, Scaffolds and Lifts 3%
	<b>G</b>	<b>H</b>	<b>I</b>
	Rigging and Hoisting Equipment 10%	Relevant Codes 3%	Customer Relations 10%
	<b>J</b>	<b>K</b>	<b>L</b>
	Introduction to Drawing Interpretation 7%	Pipe Working Skills Soldering and Brazing 34%	Materials and Fastening Devices 7%

#### SECTION TWO

<b>INTRODUCTION TO REFRIGERATION, AIR CONDITIONING AND HEATING</b>  44%	<b>A</b>	<b>B</b>	<b>C</b>
	Refrigeration Principles 13%	Vapour Compression Cycle 10%	Introduction to Refrigeration Enthalpy and Gas Laws 19%
	<b>D</b>	<b>E</b>	<b>F</b>
	Air Properties and Air Flow Designs 10%	Air Handling Systems and Accessories 10%	Air Filtration 4%
	<b>G</b>	<b>H</b>	<b>I</b>
	Refrigeration and Air Conditioning Relevant Codes 4%	Introduction to Valve Design and Functions 4%	Refrigerant and Oil Handling 13%
	<b>J</b>	<b>K</b>	<b>L</b>
	Introduction to Gasfitting Fundamentals 5%	Properties of Gas and Principles of Combustion 4%	Introduction to Gasfitting Code and Regulations 4%

#### SECTION THREE

<b>INTRODUCTION TO ELECTRICAL THEORY</b>  18%	<b>A</b>	<b>B</b>	<b>C</b>
	Introduction to Electrical Safety, Connections and Meters 18%	Current, Voltage, and Resistance 13%	Series Resistive Circuits 9%
	<b>D</b>	<b>E</b>	<b>F</b>
	Parallel Resistive Circuits 9%	Series-Parallel Resistive Circuits 14%	Methods of Producing EMF and Magnetism 18%
	<b>G</b>	<b>H</b>	
	Fundamentals of Alternating Current 14%	Arc Flash and Electrical Safety 5%	

#### SECTION FOUR

<b>INTRODUCTIONS TO CONTROLS</b>  13%	<b>A</b>	<b>B</b>	<b>C</b>
	Introduction to Control Systems 12%	Control Components 13%	Refrigeration Controls Circuits 31%
	<b>D</b>	<b>E</b>	
HVAC Controls Circuits 25%	Building Systems Controls 19%		

**SECOND PERIOD**  
**(8 Weeks/30 Hours per Week – Total of 240 Hours)**

**SECTION ONE**

<b>BASIC REFRIGERATION AND AIR CONDITIONING</b> 53%	<b>A</b>	Evaporator Feed Controls and Refrigeration Effect 13%	<b>B</b>	Automatic Flow Controls and Applications 8%	<b>C</b>	Refrigeration Accessories 3%
	<b>D</b>	Compressors 11%	<b>E</b>	Evaporators and Condensers 4%	<b>F</b>	Evaporating Condensers and Cooling Towers 5%
	<b>G</b>	System Install and Commissioning 28%	<b>H</b>	System Calculations and Analysis 19%	<b>I</b>	Retrofitting and Conversions 6%
	<b>J</b>	Split Systems 3%				

**SECTION TWO**

<b>BASIC HEATING</b> 13%	<b>A</b>	Natural Draft Burner Adjustments and Gas Consumption 19%	<b>B</b>	Pilots, Pilot Burners, Thermocouples and Thermopiles 19%	<b>C</b>	Pressure Regulators and Orifices 25%
	<b>D</b>	Introduction to Flues, Draft Hoods and Vent Connections 19%	<b>E</b>	Single Line Drawings 12%	<b>F</b>	Heating with Alternative Methods 6%

**SECTION THREE**

<b>BASIC CONTROLS</b> 14%	<b>A</b>	Principles of Automatic Heating and Cooling Controls 19%	<b>B</b>	Temperature Sensing and Control Devices 12%	<b>C</b>	Basic Gas-Fired Forced-Air Heating Systems 19%
	<b>D</b>	Mid/High-Efficiency / Gas-Fired / Forced-Air Heating Systems 19%	<b>E</b>	Basic Hot Water Heating Systems 6%	<b>F</b>	HVAC Units 25%

**SECTION FOUR**

<b>BASIC ELECTRICAL THEORY</b> 20%	<b>A</b>	Single Phase Transformers 8%	<b>B</b>	Single Phase Motors 29%	<b>C</b>	Compressor and Electrical Circuit Components 21%
	<b>D</b>	Three Phase Fundamentals 13%	<b>E</b>	Troubleshooting Electrical Problems 21%	<b>F</b>	Introduction to Canadian Electrical Code 4%
	<b>G</b>	Class 1 and Class 2 Circuits 4%				



**THIRD PERIOD**  
**(8 Weeks/30 Hours per Week – Total of 240 Hours)**

**SECTION ONE**

**INTERMEDIATE REFRIGERATION AND AIR CONDITIONING**  
 47%



**A**  
 Refrigeration Load Calculations and Design  
 21%

**B**  
 Piping Design and Installation Practices  
 32%

**C**  
 Defrosting Methods Circuits and Controls  
 9%

**D**  
 Troubleshooting of Refrigeration and HVAC Systems  
 23%

**E**  
 Ice Machines  
 4%

**F**  
 Industrial Refrigeration Systems  
 7%

**G**  
 Codes Related to Refrigeration and Air Conditioning Installations  
 4%

**SECTION TWO**

**INTERMEDIATE HEATING THEORY**  
 13%



**A**  
 Electronic Ignition Systems  
 37%

**B**  
 Natural and Fan Assisted Draft Appliances  
 38%

**C**  
 Introduction to Make Up Air  
 25%

**SECTION THREE**

**INTERMEDIATE ELECTRICAL THEORY**  
 14%



**A**  
 Three Phase Motors  
 18%

**B**  
 Motor Installations  
 41%

**C**  
 Variable Speed Drives  
 24%

**D**  
 Diagrams  
 17%

**SECTION FOUR**

**AIR HANDLING THEORY**  
 26%



**A**  
 HVAC Load Calculations and Design  
 22%

**B**  
 Advanced Air Properties  
 16%

**C**  
 Air Conditioning Systems  
 52%

**D**  
 Air Instruments and System Balancing  
 10%

**FOURTH PERIOD**  
**(8 Weeks/30 Hours per Week – Total of 240 Hours)**

**SECTION ONE**

**ADVANCED REFRIGERATION THEORY** 33%



<b>A</b>	<b>B</b>	<b>C</b>
Chillers 18%	Ultra Low Compression Systems 12%	Multiplex Systems 20%
<b>D</b>	<b>E</b>	<b>F</b>
Industrial Refrigeration Systems 25%	Circulating Pumps 10%	B52 Piping Codes and Canadian Code of Practice 5%
<b>G</b>		
Advanced Drawing Interpretation 10%		

**SECTION TWO**

**ADVANCED HEATING THEORY** 20%



<b>A</b>	<b>B</b>	<b>C</b>
Troubleshooting Gas Fired Equipment 21%	Combustion Analysis 17%	Advanced Make-up Air Systems 33%
<b>D</b>	<b>E</b>	
Troubleshooting Make-up Air Systems 21%	Workplace Coaching Skills 8%	

**SECTION THREE**

**COMPLEX AIR SYSTEM THEORY** 17%



<b>A</b>	<b>B</b>	<b>C</b>
Complex HVAC Systems 25%	Troubleshooting Complex HVAC Systems 30%	Advanced Mechanical Drives for Fan Systems 13%
<b>D</b>	<b>E</b>	
Installation of HVAC Equipment 20%	Energy Management Systems (EMS) and Indoor Air Quality 12%	

**SECTION FOUR**

**ADVANCED CONTROL SYSTEMS** 30%



<b>A</b>	<b>B</b>	<b>C</b>
Specialized Electronic Control Systems 22%	Electromechanical Control Systems 17%	Advanced Electrical Troubleshooting 14%
<b>D</b>	<b>E</b>	<b>F</b>
Schematic Diagrams 14%	Economizer Controls and Accessories 19%	New Environmental Technology 11%
<b>G</b>		
Interprovincial Standards Red Seal Program 3%		

**FIRST PERIOD TECHNICAL TRAINING  
REFRIGERATION AND AIR CONDITIONING MECHANIC TRADE  
CURRICULUM GUIDE**

*UPON SUCCESSFUL COMPLETION OF THIS COURSE THE APPRENTICE SHOULD BE ABLE TO  
PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.*

**SECTION ONE:..... OCCUPATIONAL SKILLS ..... 25%**

**A. Safety Legislation, Regulations & Industry Policy in the Trades ..... 3%**

**Outcome:**     ***Apply legislation, regulations and practices ensuring safe work in this trade.***

1. Demonstrate the application of the Occupational Health and Safety Act, Regulation and Code.
2. Describe the sponsor's and employee's role with Occupational Health and Safety (OH&S) regulations, Worksite Hazardous Materials Information Systems (WHMIS), fire regulations, Workers Compensation Board regulations and related advisory bodies and agencies.
3. Describe industry practices for hazard assessment and control procedures.
4. Describe the responsibilities of worker and sponsors to apply emergency procedures.
5. Describe tradesperson attitudes with respect to housekeeping, personal protective equipment and emergency procedures.
6. Describe the roles and responsibilities of sponsors and employees with the selection and use of personal protective equipment (PPE).
7. Maintain required PPE for tasks.
8. Use required PPE for tasks.

**B. Climbing, Lifting, Rigging and Hoisting ..... 2%**

**Outcome:**     ***Use industry standard practices for climbing, lifting, rigging and hoisting in this trade.***

1. Describe manual lifting procedures.
2. Describe rigging hardware and associated safety factors.
3. Select equipment for rigging loads.
4. Describe hoisting and load moving procedures.
5. Maintain personal protective equipment (PPE) for climbing, lifting and load moving equipment.
6. Use PPE for climbing, lifting and load moving equipment.

**C. Hazardous Materials & Fire Protection ..... 5%**

**Outcome:**     ***Apply industry standard practices for hazardous materials and fire protection in this trade.***

1. Describe roles, responsibilities, features and practices related to the Workplace Hazardous Materials Information System (WHMIS) program.
2. Describe three key elements of WHMIS.
3. Describe handling, storing and transporting procedures for hazardous material.
4. Describe venting procedures when working with hazardous materials.
5. Describe hazards, classes, procedures and equipment related to fire protection.

**D. Apprenticeship Training Program..... 3%****Outcome: Manage an apprenticeship to earn journeyperson certification.**

1. Describe the contractual responsibilities of the apprentice, sponsor and Alberta Apprenticeship and Industry Training.
2. Describe the purpose of the apprentice competency portfolio.
3. Describe the procedure for changing employers during an active apprenticeship.
4. Describe the purpose of the curriculum guide.
5. Describe the procedure for progressing through an apprenticeship.
6. Describe advancement opportunities in this trade.

**E. Tools and Instruments ..... 13%****Outcome: Use hand tools and power tools.**

1. Describe types, uses and care of hand, power tools and instruments.
2. Demonstrate the use of hand tools and power tools used in the industry.
3. Demonstrate connections of refrigeration gauges and operation of service valves.
4. Perform calculations related to measurement using imperial and metric units.

**F. Ladders, Scaffolds and Lifts ..... 3%****Outcome: Use ladders, scaffolds and lifts.**

1. Describe the use of various types of ladders.
2. Describe the use of various types of scaffolds.
3. Describe the use of various types of lifts.

**G. Rigging and Hoisting Equipment..... 10%****Outcome: Use rope and rigging components to hoist equipment.**

1. Describe the various types, parts, care and maintenance of natural and synthetic rope.
2. Identify and describe the proper procedure for tying popular knots, and hitches.
3. Describe types, parts and care and maintenance of wire ropes.
4. Name differences between chain falls, come-a-longs, tiffors and snatch blocks.
5. Describe characteristics of safe workloads of slings used for hoisting pipe, appliances and components.
6. Describe hand signals when directing a crane.
7. Demonstrate tying of knots, and hitches.

**H. Relevant Codes..... 3%****Outcome: Apply codes used in the refrigeration and air conditioning (RAC) industry.**

1. Describe the refrigeration codes that apply to RAC work.
2. Describe the gas codes that apply to RAC work.
3. Describe the plumbing codes that apply to RAC work.

4. Describe the electrical codes that apply to RAC work.
5. Describe the sheet metal codes that apply to RAC work.

**I. Customer Relations..... 10%**

**Outcome: Demonstrate effective customer relations.**

1. Describe effective communication techniques.
2. Describe methods used to determine customers' needs.
3. Describe customer reporting methods.
4. Describe job completion strategies.

**J. Introduction to Drawing Interpretation..... 7%**

**Outcome: Interpret basic drawings information.**

1. Use basic information found on drawings.
2. Interpret basic drawings.
3. Identify common symbols used in drawings and legends.
4. Identify abbreviations used in drawings.

**K. Pipe Working Skills, Soldering and Brazing..... 34%**

**Outcome: Apply pipe working skills on refrigeration, gas and plumbing pipe.**

1. Describe tools, equipment and material used for pipe work.
2. Describe tools and equipment used for soldering.
3. Describe tools and equipment used for brazing.
4. Describe oxyfuel equipment components, functions and maintenance.
5. Describe procedures of oxyfuel equipment use.
6. Demonstrate use of tools, equipment and material for pipe work.
7. Demonstrate use of tools and equipment for soldering.
8. Demonstrate use of tools and equipment for brazing.
9. Demonstrate oxyfuel leak detection, adjusting, operating, and shutdown procedures.

**L. Materials and Fastening Devices..... 7%**

**Outcome: Use materials and fasteners commonly used in the industry.**

1. Describe metallic and non-metallic materials' characteristics and applications.
2. Describe types of threaded fasteners and their applications.
3. Describe thread repair methods.
4. Describe types of non-threaded fasteners and their applications.
5. Demonstrate removal of seized and damaged fasteners.

**SECTION TWO: INTRODUCTION TO REFRIGERATION, AIR CONDITIONING AND HEATING..... 44%****A. Refrigeration Principles ..... 13%****Outcome: Explain the basic operation of a refrigeration system.**

1. Define terms related to refrigeration principles.
2. Describe basic concepts of heat transfer.
3. Describe methods of heat transfer.
4. Describe the laws of thermal dynamics.
5. Describe the units of measure pertaining to heat transfer.
6. Describe the function of refrigeration in transportation.
7. Perform calculations related to heat transfer.
8. Convert temperatures and pressures between various scales.

**B. Vapour Compression Cycle ..... 10%****Outcome: Explain the vapour compression cycle.**

1. Describe basic concepts of the vapour compression cycle.
2. Describe the four essential components of a refrigeration system.
3. Describe the stages of the refrigeration cycle.
4. Describe basic operating principles and applications of multiple evaporator systems.
5. Describe the basic difference between single and multiple evaporator systems.
6. Measure the refrigeration cycle on a working system.
7. Demonstrate the operation of a refrigeration system using a diagram.

**C. Introduction to Refrigeration Enthalpy and Gas Laws ..... 19%****Outcome: Apply gas laws and pressure enthalpy charts to refrigeration systems.**

1. Define terms used in refrigeration and heating.
2. Describe gas laws and how they apply to thermal dynamics.
3. Describe fluids and fluid piping systems as it relates to refrigeration systems.
4. Describe the units of measurement used in refrigeration calculations.
5. Apply formulas used in calculating gas laws and pressure enthalpy.
6. Describe the components of a pressure enthalpy diagram.
7. Plot a basic cycle using a pressure enthalpy diagram.
8. Demonstrate use of formulas for calculating gas laws and pressure enthalpy.

**D. Air Properties and Air Flow Designs ..... 10%****Outcome: Apply the properties of air as it relates to basic air flow design.**

1. Describe air properties as it relates to heat transfer.
2. Describe methods of heat transfer as they relate to air flow.
3. Describe units of measurement as it relates to air properties.
4. Describe methods used in calculating air flow design.

5. Calculate air flow required for a given heat transfer system.
6. Describe psychrometrics.
7. Describe the meaning, function and uses of psychrometric charts.
8. Plot and interpret a psychrometric chart.

**E. Air Handling Systems and Accessories..... 10%**

**Outcome: Service air handling systems and accessories.**

1. Describe air handling systems.
2. Describe air handling systems components.
3. Describe air handling accessories.
4. Describe air handling equipment maintenance requirements.
5. Define terms and components used in fans, belts and mechanical drives.
6. Demonstrate fan belt installation and mechanical drive alignment.

**F. Air Filtration ..... 4%**

**Outcome: Analyze efficiencies of air filtration systems.**

1. Define terms related to filtration.
2. Define filtration components and their application.
3. Describe the operation and efficiency of air filters.
4. Calculate velocities and pressure drops through filters.

**G. Refrigeration and Air Conditioning Relevant Codes ..... 4%**

**Outcome: Apply the B52 Mechanical Refrigeration Code and the Canadian Code of Practice in the Refrigeration and Air Conditioning industry work in Alberta.**

1. Explain the scope and jurisdiction of the different codes.
2. Describe how the B52 relates to the Refrigeration and Air Conditioning industry.
3. Describe how the Canadian Code of Practice relates to the Refrigeration and Air Conditioning industry.
4. Demonstrate how the B52 is used in determining minimum standards in refrigeration and air conditioning install and maintenance work.
5. Demonstrate how the Canadian Code of Practice is used in determining minimum standards in a refrigeration and air conditioning install and maintenance work.

**H. Introduction to Valve Design and Functions ..... 4%**

**Outcome: Maintain or repair valves in RAC systems.**

1. Describe general valve designs.
2. Describe applications of various valves.
3. Describe valve designs for various RAC system applications.
4. Describe the purpose, types and procedures for service valves.
5. Describe the purpose, types, construction, location and operation of RAC valves.
6. Demonstrate operation of service valves.

**I. Refrigerant and Oil Handling..... 13%**

**Outcome: Handle refrigerant and refrigeration oil safely.**

1. Describe the evolution and properties of refrigerants and their oils.
2. Describe the safe handling and storage of refrigerants and refrigeration oils.
3. Describe the safe recovery and disposal of refrigerants and refrigeration oils.
4. Describe leak testing methods and instruments used.
5. Describe the evacuation process of refrigeration systems.
6. Describe non OEM refrigerant products available in the industry.
7. Demonstrate the safe recovery and disposal of refrigerants.
8. Demonstrate the safe recovery and disposal of refrigeration oils.
9. Demonstrate leak testing methods and instruments used.
10. Demonstrate the evacuation process of refrigeration systems.
11. Demonstrate the proper maintenance procedures of recovery and evacuation equipment.
12. Demonstrate cleaning procedures for a contaminated system.
13. Complete Heating Refrigeration Air Conditioning Institute (HRAI) refrigerant handling training.

**J. Introduction to Gasfitting Fundamentals..... 5%**

**Outcome: Explain and identify basic gas fundamentals and the purpose, legal status and organization of CAN/CSA Natural Gas and Propane Installation Codes B149.1, B149.2 and the Gas Bulletins.**

1. Describe historical foundations, career opportunities and trade regulatory structure.
2. Describe production, distribution and storage of natural gas.
3. Describe production, distribution and storage of propane gas.
4. State regulations pertaining to the general requirements of the gasfitter trade.
5. Interpret regulations pertaining to the gasfitter trade.

**K. Properties of Gas and Principles of Combustion.....4%**

**Outcome: Explain basic gas fundamentals.**

1. Identify chemical formulas used by the Refrigeration and Air Conditioning Mechanic trade.
2. Describe the relative densities, liquefaction ratios and heating value of gases.
3. Calculate appliance input values using properties of gases.
4. Identify definitions specific to combustion.
5. Explain the principles of combustion as a chemical change.
6. Describe the products of complete and incomplete combustion.
7. Describe the requirements for combustion air.
8. Describe flame adjustment techniques and safety practices when adjusting gas-fired equipment.



**L. Introduction to Gasfitting Code and Regulations ..... 4%**

**Outcome:** *Apply standards pertaining to the installation of piping and tubing systems for various conditions of use in accordance with the CAN/CSA B149.1 Natural Gas and Propane Installation Codes (Sections 1-4) and B149.2 Propane Storage and Handling and the Gas Safety Information Bulletins.*

1. Describe the regulations contained in the scope section of the CAN/CSA B149.1 Natural Gas and Propane Installation Codes, amendments to the code and the regulations pertaining to installer's responsibilities.
2. List the regulations contained in the CAN/CSA B149.1 Natural Gas and Propane Installation Codes and B149.2 Propane Storage and Handling and the Gas Safety Information Bulletins pertaining to installation of piping and fittings.
3. List the regulations contained in the CAN/CSA B149.1 Natural Gas and Propane Installation Codes and B149.2 Propane Storage and Handling and the Gas Safety Information Bulletins pertaining to testing of piping and fittings.
4. List the regulations contained in the CAN/CSA B149.1 Natural Gas and Propane Installation Codes and B149.2 Propane Storage and Handling and the Gas Safety Information Bulletins pertaining to purging of piping and fittings.
5. Describe safety practices pertaining to installation of piping and fittings.
6. Describe safety practices pertaining to testing of piping and fittings.
7. Describe safety practices pertaining to purging of piping and fittings.

**SECTION THREE: .....INTRODUCTION TO ELECTRICAL THEORY ..... 18%**

**A. Introduction to Electrical Safety, Connections and Meters ..... 18%**

**Outcome:** *Use safe work practices on electrically energized equipment.*

1. Describe the hazards related to working with electrical circuits.
2. Describe safety precautions when working with electrical circuits.
3. Describe the physical properties of conductors, semiconductors and insulators.
4. Describe lockout tag out procedures related to working on electrical equipment.
5. Describe types of electrical connections.
6. State the applications of the various meters.
7. List the care and precautions associated with using meters.
8. Identify the connections for meters.
9. Demonstrate electrical connections.
10. Demonstrate range selection and connections of voltmeter, ammeter, ohmmeter and insulation testers.

**B. Current, Voltage, and Resistance ..... 13%**

**Outcome:** *Apply knowledge of voltage, current and resistance and determine how changing the value of any one of them affects the circuit.*

1. Describe an electric current.
2. Describe voltage, current and power.
3. Describe resistance and state and apply Ohm's Law.
4. Connect and verify relationships between voltage, current and resistance according to Ohm's Law.

**C. Series Resistive Circuits..... 9%**

**Outcome:** *Connect a series resistive circuit and analyze the relationships between current, resistance and voltage.*

1. Define a series circuit.
2. Apply the formula for total resistance in a series circuit.
3. Apply Kirchhoff's voltage law to a series circuit.
4. Determine the voltage drop across a closed-or-open-circuit component in a series circuit.
5. Connect and verify Kirchhoff's current and voltage laws in a series resistive circuit.

**D. Parallel Resistive Circuits..... 9%**

**Outcome:** *Connect a parallel resistive circuit and analyze the relationships between current, resistance and voltage.*

1. Define a parallel circuit.
2. Apply the formula for a total resistance in a parallel circuit.
3. Apply Kirchhoff's current law to a parallel circuit.
4. Describe the effects of open circuits on a parallel circuit.
5. Connect and verify Kirchhoff's current law in a parallel resistive circuit.

**E. Series-Parallel Resistive Circuits ..... 14%**

**Outcome:** *Connect and analyze a series-parallel resistive circuit.*

1. Identify resistors that are in series.
2. Identify resistors that are in parallel.
3. Calculate the total resistance of a series-parallel circuit.
4. Apply Kirchhoff's current law.
5. Apply Kirchhoff's voltage law.
6. Solve problems involving series-parallel circuits.
7. Connect and verify the relationship of current, voltage and resistance in each part of a series/parallel circuit.

**F. Methods of Producing Electro Motive Force (EMF) and Magnetism ..... 18%**

**Outcome:** *Apply knowledge of EMF when servicing RAC equipment.*

1. Describe the production of EMF by using chemicals.
2. Describe the production of EMF by using heat.
3. Describe the production of EMF by using pressure.
4. Describe the production of EMF by using light.
5. Describe the production of EMF by using magnetism.
6. Describe the production of EMF by using electrostatics.
7. Describe the properties of magnetic materials.
8. Define the terminology related to magnetism.
9. Describe electromagnetism and basic design considerations for electromagnetic devices.

10. Describe how an induced voltage is generated.
11. Describe the process of electromagnetic induction.

**G. Fundamentals of Alternating Current..... 14%**

**Outcome:     *Apply knowledge of ac circuits when servicing RAC equipment.***

1. Describe the generation of an ac sine wave.
2. Determine the output frequency of an ac generator.
3. Calculate standard ac sine wave values.
4. Demonstrate the relationship between sine waves and phasor diagrams.
5. List the factors affecting impedance in an ac circuit.

**H. Arc Flash and Electrical Safety..... 5%**

**Outcome:     *Recognize arc flash hazards in electrical installations.***

1. Identify the hazards associated with arc flash.
2. Describe the personal protective equipment related to arc flash.
3. Describe lockout procedures related to energized systems.

**SECTION FOUR: .....INTRODUCTION TO CONTROLS ..... 13%**

**A. Introduction to Control Systems ..... 12%**

**Outcome:     *Service control systems used for heating and cooling.***

1. Describe terminology used in control systems.
2. Describe heating and cooling controls.
3. Describe heating and cooling control systems.
4. Interpret electrical diagrams used to show the function of a heating or cooling control system.

**B. Control Components..... 13%**

**Outcome:     *Service components used in control systems.***

1. Describe the components of heating and cooling systems.
2. Describe the construction of control system components.
3. Describe the application of control components for heating and cooling system.
4. Describe the operation of control system components.

**C. Refrigeration Control Circuits..... 31%**

**Outcome:     *Use control circuits for refrigeration systems.***

1. Describe components used in control circuits for refrigeration systems.
2. Describe the differences between medium and low temperature control circuits.
3. Describe the components of a medium temperature control circuit.
4. Describe the components of a low temperature control circuit.
5. Connect and verify operation of a medium temperature cooling control system.
6. Connect and verify operation of a low temperature cooling control system.

**D. Heating Ventilating Air Conditioning (HVAC) Control Circuits..... 25%**

**Outcome: Use control circuits for HVAC systems.**

1. Describe components used in HVAC control circuits.
2. Describe the construction of HVAC control system components.
3. Describe the application of control components for HVAC system.
4. Describe the operation of HVAC control system components.
5. Connect and verify operation of a HVAC control system.

**E. Building Systems Controls..... 19%**

**Outcome: Service building system control circuits.**

1. Describe components used in building control circuits.
2. Describe components and their applications of a pneumatic control system.
3. Describe the construction of building control system components.
4. Describe the application of control components for building control systems.
5. Describe the operation of building control systems.
6. Describe other systems that affect building control systems.

**SECOND PERIOD TECHNICAL TRAINING  
REFRIGERATION AND AIR CONDITIONING MECHANIC TRADE  
CURRICULUM GUIDE**

*UPON SUCCESSFUL COMPLETION OF THIS COURSE THE APPRENTICE SHOULD BE ABLE TO PERFORM  
THE FOLLOWING OUTCOMES AND OBJECTIVES.*

**SECTION ONE:..... BASIC REFRIGERATION AND AIR CONDITIONING.....53%**

**A. Evaporator Feed Controls and Refrigeration Effect ..... 13%**

**Outcome:      *Service evaporator feed controls on refrigeration equipment.***

1. Define terms related to evaporator feed control and refrigeration effect.
2. Describe types and operations of evaporator feed controls.
3. Describe components of evaporator feed control systems.
4. Describe control characteristics of expansion control devices.
5. Describe methods of producing the refrigeration effect.
6. Determine the proper metering device for various applications.
7. Demonstrate troubleshooting techniques of metering devices.
8. Measure superheat and adjust a thermal expansion valve (TXV).

**B. Automatic Flow Controls and Applications ..... 8%**

**Outcome:      *Use automatic flow controls in a refrigeration system.***

1. Define terms related automatic flow controls.
2. Describe components of automatic flow controls.
3. Describe the operation of automatic flow controls.
4. Describe the application of automatic flow controls.
5. Demonstrate service of automatic flow controls.

**C. Refrigeration Accessories ..... 3%**

**Outcome:      *Maintain and repair refrigeration accessories.***

1. Define terms related to refrigeration accessories.
2. Describe components related to refrigeration accessories.
3. Describe the operation of various refrigeration accessories.
4. Describe the application of various refrigeration accessories.

**D. Compressors ..... 11%**

**Outcome:      *Perform compressor diagnosis and repairs.***

1. Define terms related to compressors and refrigeration circuit components.
2. Describe types of compressors used in refrigeration and air conditioning systems.
3. Describe the components and operating characteristics of compressors.
4. Define terms related to compressor mechanical components.
5. Describe compressor components and their applications.

6. Describe the compression process and the flow of gas through the compressor.
7. Describe types of compressor lubrication.
8. Describe mechanical and electrical oil failure controls.
9. Describe capacity control systems.
10. Label a compressor circuit.
11. Disassemble and reassemble a small semi hermetic compressor.
12. Identify direction of rotation for lubrication.
13. Install, wire and check the operation of an oil failure control.

**E. Evaporators and Condensers ..... 4%**

**Outcome:** *Explain the operation and components of evaporators and condensers.*

1. Define terms related to evaporators and condensers.
2. Describe evaporator components and their applications.
3. Describe evaporator defrost methods.
4. Describe condenser components and their applications.
5. Describe service and repair of evaporators and condensers.
6. Describe how distributors avoid excessive pressure drops in a system.
7. Demonstrate evaporator and condenser sizing and balancing methods.

**F. Evaporative Condensers and Cooling Towers ..... 5%**

**Outcome:** *Explain the operation and components of evaporative condensers and cooling towers.*

1. Define terms related to evaporative condensers and cooling towers.
2. Describe evaporative condenser components and their applications.
3. Describe cooling tower components and their applications.
4. Describe water treatment procedures as it relates to cooling towers.
5. Describe seasonal operation of cooling towers.

**G. System Install and Commissioning ..... 28%**

**Outcome:** *Performs system install and commissioning of refrigeration and air conditioning (RAC) systems.*

1. Describe methods of selecting and locating system components.
2. Describe methods of mounting condensing units and evaporators.
3. Describe methods of connecting piping and accessories to an RAC system.
4. Compare the use of various piping materials.
5. Sketch an electrical wiring schematic for an RAC system.
6. Sketch a piping schematic for an RAC system.
7. Install and connect an RAC system.

8. Start-up an RAC system.
9. Complete a commissioning report for an RAC system.

**H. System Calculation and Analysis ..... 19%**

**Outcome: Troubleshoot, calculate and analyze refrigeration and air conditioning (RAC) systems.**

1. Define thermal dynamics as it pertains to service and troubleshooting of RAC systems.
2. Describe pressure enthalpy diagrams as they relate to various RAC system conditions.
3. Describe formulas used in analyzing system thermal dynamics.
4. Analyze and troubleshoot RAC systems using pressure enthalpy diagrams and system thermal dynamic formulas.
5. Use tools and charts to troubleshoot RAC systems under various conditions.

**I. Retrofitting and Conversions ..... 6%**

**Outcome: Perform retrofitting and conversions on RAC equipment.**

1. Describe steps used in designing and retrofitting or converting RAC systems.
2. Describe the hazards related to retrofitting or converting RAC systems.
3. Describe start-up and monitoring steps of a retrofitted or converted RAC system.

**J. Split Systems ..... 3%**

**Outcome: Service split cooling systems.**

1. Identify the components used in a typical cooling system.
2. Describe the operation of a typical cooling system.
3. Identify the requirements for combining a basic cooling system with an existing forced-air heating system.
4. Observe the operation of a combined heating and cooling system.

**SECTION TWO: ..... BASIC HEATING ..... 13%**

**A. Natural Draft Burner Adjustments and Gas Consumption ..... 19%**

**Outcome: Install and adjust pressure controls and gas-fired burners using ratings plates, gas meters, manometers and mechanical gauges to optimize consumption for gas-fired appliances.**

1. Determine appliance settings using rating plates, altitude designation and listed approval agencies.
2. Describe the requirements from the CAN/CSA B149.1 Natural Gas and Propane Installation Codes, CAN/CSA B149.2 Propane Storage and Handling Code and the Plumbing and Gas Safety Service Bulletin pertaining to gas appliance and adjustments and installer’s responsibilities.
3. Define parts of a burner and burner terminology.
4. Measure manifold pressures to determine gas consumption of burners in both imperial and metric units.
5. Adjust orifices and manifold pressures to optimize gas consumption.
6. Identify meter dials and meter indexes in both metric and imperial units.
7. Explain principles of low pressure gas meter clocking.

8. Calculate gas consumption using timed meter readings.

**B. Pilots, Pilot Burners, Thermocouples and Thermopiles ..... 19%**

**Outcome: Service pilots, pilot burners, thermocouples and thermopiles.**

1. Describe pilot burner types and terminology.
2. Describe characteristics of pilot burners
3. Identify parts of aerated and non-aerated pilot burners.
4. State the primary purpose of a gas pilot
5. Describe burner ignition tests performed on all pilots.
6. Describe operating principles of thermocouples and thermopiles.
7. Describe the operation tests performed on proven pilots energizing a thermocouple.
8. Describe methods of installing thermocouples and thermopiles on standard circuits.
9. Describe operational tests performed on thermocouples and thermopiles.
10. Describe diagnostic tests for thermocouples.
11. State causes for thermocouple failures.

**C. Pressure Regulators and Orifices ..... 25%**

**Outcome: Service gas pressure controls and burner orifices and adjust gas line pressure.**

1. Describe types, operating principles and applications or various gas pressure regulators.
2. Identify regulator sizing tables and list and describe correct installation procedures for various regulators.
3. Describe maintenance procedures for various regulators.
4. Describe pressure regulator problems and corrective procedures.
5. Identify types of orifices.
6. Use orifice sizing charts to determine orifice sizing for specific gas consumptions and pressure in both metric and imperial units.
7. Drill an orifice according to specific gas requirements.
8. Demonstrate procedures for testing an orifice and adjust manifold pressure on HVAC equipment.

**D. Introduction to Flues, Draft Hoods and Vent Connections ..... 19%**

**Outcome: Service draft hoods and vent connectors.**

1. Define terminology pertaining to flues and draft control devices.
2. Describe flue collars and types of draft hoods including installation procedures.
3. Explain regulations pertaining to the sizing, installation and use of draft hoods on gas burning appliances as listed in the CAN/CSA B149.1 *Natural Gas and Propane Installation Code and STANDATA*.
4. Describe installation procedures for single and double acting barometric dampers.
5. Explain regulations pertaining to the selection, sizing, installation and use of draft control devices as specified in the CAN/CSA B149.1 *Natural Gas and Propane Installation Code and STANDATA*.
6. Describe vent connectors and installation techniques.



7. Explain regulations pertaining to vent connectors as listed in the CAN/CSA B149.1 *Natural Gas and Propane Installation Code and STANDATA*.
8. Size vent connectors using minimum size rules.

**E. Single Line Drawings ..... 12%**

**Outcome: Draw and interpret basic orthographic and isometric drawings.**

1. Draw and label the three views of orthographic drawings.
2. Draw sections of a simple object.
3. Draw and label orthographic single-line piping drawings with 90° elbows and tees and convert to isometric drawings.
4. Draw and label isometric single-line piping drawings containing 90° elbows and tees.

**F. Heating with Alternative Methods..... 6%**

**Outcome: Service alternative heating systems.**

1. Describe alternative heat sources.
2. Describe alternative heat source systems.

**SECTION THREE: ..... BASIC CONTROLS ..... 14%**

**A. Principles of Automatic Heating and Cooling Controls ..... 19%**

**Outcome: Explain the basic principles for automatic controls for heating and cooling systems.**

1. Describe the basic requirements of heating and cooling systems.
2. Describe the control components of a basic forced-air heating system.
3. Interpret basic electrical diagrams used to show the function of a heating or cooling control system.
4. Identify code requirements relating to the electrical installation of heating and cooling systems.

**B. Temperature Sensing and Control Devices ..... 12%**

**Outcome: Service temperature sensing and control devices.**

1. Identify operating characteristics of temperature-sensing devices.
2. Describe the application of temperature-sensing devices used in heating and cooling systems.
3. Describe the functions of thermostats in heating and cooling systems.

**C. Basic Gas-Fired Forced-Air Heating Systems ..... 19%**

**Outcome: Connect and troubleshoot basic 24 V and 120 V gas-fired, forced-air heating systems.**

1. Identify the components used in a basic gas-fired, forced-air heating system.
2. Describe the operation of a domestic heating system using a 24 V control circuit.
3. Describe the operation of a unit heater using a 120 V control circuit.
4. Describe the installation and operation of a fan interlock system on a residential forced air heating system.
5. Connect and verify a 24 V and 120 V control heating system.
6. Diagnose and repair 24 V and 120 V heating systems.

**D. Mid/High-Efficiency / Gas-Fired / Forced-Air Heating Systems..... 19%**

**Outcome: Connect and troubleshoot mid and high-efficiency, gas-fired, forced-air heating systems.**

1. Identify the components of a mid-efficiency, gas-fired, forced-air heating system.
2. Troubleshoot a mid-efficiency, gas-fired, forced-air heating system.
3. Troubleshoot a high-efficiency, gas-fired, forced-air heating system.
4. Describe the purpose of and application of auxiliary equipment used with gas-fired, forced-air heating systems.
5. Connect and verify the operation of a direct spark ignition system in a high-efficiency gas-fired furnace.
6. Connect and verify the operation of a hot surface ignition system in a high-efficiency gas-fired furnace.

**E. Basic Hot Water Heating Systems..... 6%**

**Outcome: Troubleshoot basic hot water heating systems.**

1. Describe the operation of a basic hot water heating system.
2. Identify the purpose and application of the components of a hot water heating system.
3. Analyze and troubleshoot the operation of a hot water heating system.

**F. HVAC Units ..... 25%**

**Outcome: Troubleshoot a basic commercial heating and cooling control circuit for an HVAC unit.**

1. Describe the components of an HVAC unit.
2. Describe the operation of an HVAC unit.
3. Describe the applications of thermostats.
4. Describe procedures for troubleshooting a HVAC unit.
5. Troubleshoot the operation of a HVAC unit.

**SECTION FOUR: .....BASIC ELECTRICAL THEORY ..... 20%**

**A. Single-Phase Transformers..... 8%**

**Outcome: Connect single-phase transformers on refrigeration RAC equipment.**

1. Describe the construction of a mutual induction transformer.
2. Describe the construction of a single winding transformer.
3. Determine the transformation ratio and volts-per-turn value of a transformer.
4. Describe transformer operation.
5. Describe the operation of current limiting (Class 2) transformers.
6. Describe the efficiencies of a transformer.
7. Calculate the efficiency of a transformer.
8. Describe the connection options for a multiple winding transformer.
9. Identify, connect and perform tests on transformers.

**B. Single Phase Motors ..... 29%**

**Outcome: Connect and service split-phase, single phase motors.**

1. Describe the components, principles of operation and applications of a resistance split-phase motor.
2. Describe the components, principles of operation and applications of a capacitor-start motor.
3. Draw connection diagrams for single phase motors.
4. Describe the components, principle of operation and applications of a permanent-split-capacitor motor.
5. Describe the components, principle of operation and applications of a capacitor start/capacitor run motor.
6. Connect and analyze a dual voltage motor and reverse it.
7. Connect and analyze a multispeed single phase motor.

**C. Compressors and Electrical Circuit Components ..... 21%**

**Outcome: Connect and service compressors and circuit components.**

1. Describe motor starters and relays of compressors.
2. Describe motor protection used for compressors.
3. Sketch a motor starter circuit.
4. Sketch a compressor overload circuit.
5. Connect a single phase compressor circuit.
6. Troubleshoot motor failures and clean up procedures.

**D. Three Phase Fundamentals ..... 13%**

**Outcome: Service three phase electrical systems on RAC equipment.**

1. Describe the difference between single phase power and three phase power.
2. Describe the generation of the phase voltages of a three phase system.
3. Describe the phase sequence of three phase sine waves.
4. Describe the advantages and disadvantages of three phase power over single phase power.

**E. Troubleshooting Electrical Problems ..... 21%**

**Outcome: Solve electrical related problems in refrigeration and HVAC circuits.**

1. Describe electrical problems common to refrigeration and HVAC circuits.
2. Describe methods used to test circuits in refrigeration and HVAC circuits.
3. Describe the possible effects of over voltage and under voltage on motors.
4. Describe the importance of full load amps, lock rotor amps and free running amps.
5. Use wiring diagrams to troubleshoot refrigeration and HVAC circuits.
6. Diagnose electrical motor problems using systematic test flowcharts.
7. Troubleshoot motors that are operating at higher than normal temperatures.
8. Perform tests on other electrical devices related to motor circuits.

**F. Introduction to Canadian Electrical Code..... 4%**

**Outcome:** *Apply the Canadian Electrical Code (CEC) Part I, and the Alberta Electrical STANDATA to verify electrical installations in Alberta.*

1. Describe the purpose of the CEC Part 1.
2. Describe the procedures for the acceptance of the CEC by the provinces and the local authorities.
3. Describe the function of the electrical STANDATA.
4. Describe the organizational layout of the CEC.
5. Identify those responsible for an electrical installation.

**G. Class 1 and Class 2 Circuits..... 4%**

**Outcome:** *Verify CEC requirements for Class 1 and Class 2 Circuits on RAC equipment.*

1. Define the terms from the CEC on Class 1 and Class 2 circuits.
2. Identify the requirements for Class 1 and Class 2 circuits.
3. Identify the Class 2 circuits as they apply to industry.

**THIRD PERIOD TECHNICAL TRAINING  
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THE FOLLOWING OUTCOMES AND OBJECTIVES.*

**SECTION ONE:..... INTERMEDIATE REFRIGERATION AND AIR CONDITIONING ..... 47%**

**A. Refrigeration Load Calculations, Designs and Equipment Selection..... 21%**

***Outcome: Calculate loads for refrigeration systems and select equipment.***

1. Describe terminology and formulas used in refrigeration load calculations.
2. Describe refrigeration loads.
3. Describe short and long methods of load calculating.
4. Describe infiltration loads and food preservation.
5. Calculate refrigeration load requirements.
6. Describe terminology and formulas used in system design and equipment selection.
7. Describe refrigeration systems and equipment.
8. Describe equipment applications and limitations.
9. Select refrigeration equipment components.

**B. Piping Design and Installation Practices ..... 32%**

***Outcome: Design and install refrigeration and HVAC systems.***

1. Describe terminology and formulas used in piping design.
2. Describe refrigeration and HVAC piping systems.
3. Describe piping applications and limitations.
4. Describe gas defrosting piping methods.
5. Calculate requirements for refrigeration and HVAC piping systems.
6. Connect and analyze a low temperature refrigeration system and components.
7. Analyze the design and installation of a medium temperature refrigeration system and components.
8. Analyze the design and installation of a split HVAC system and components.

**C. Defrosting Methods Circuits and Controls ..... 9%**

***Outcome: Service defrosting circuits and controls.***

1. Describe terminology and formulas used in defrosting circuits and controls.
2. Describe methods of defrosting.
3. Describe defrosting components and their applications.
4. Install, connect and analyze defrosting components.

**D. Troubleshooting of Refrigeration and HVAC Systems..... 23%**

***Outcome: Solve problems in refrigeration and HVAC systems.***

1. Describe electrical problems with refrigeration and HVAC systems.

2. Describe oil problems with refrigeration and HVAC systems.
3. Describe refrigerant problems with refrigeration and HVAC systems.
4. Describe compressor problems with refrigeration and HVAC systems.
5. Describe piping problems with refrigeration and HVAC systems.
6. Describe air flow problems with refrigeration and HVAC systems.
7. Describe methods used to test circuits in refrigeration and HVAC systems.
8. Use test equipment to troubleshoot refrigeration and HVAC system problems.

**E. Ice Machines ..... 4%**

**Outcome:      *Install and maintain ice machines.***

1. Describe the operation of ice machines.
2. Describe the harvest methods of ice machines.
3. Describe the maintenance of ice machines.
4. Describe the cleaning of ice machines.
5. Connect and analyze ice machines.

**F. Industrial Refrigeration Systems ..... 7%**

**Outcome:      *Service industrial refrigeration systems.***

1. Describe terminology used in industrial refrigeration systems.
2. Describe components of industrial refrigeration systems.
3. Describe applications and limitations of industrial refrigeration components.
4. Describe designs of industrial refrigeration systems.
5. Observe an industrial refrigeration system in operation.

**G. Codes Related to Refrigeration and Air Conditioning Installations ..... 4%**

**Outcome:      *Apply the B52 Mechanical Refrigeration Code and the Canadian Code of Practice to install Refrigeration and Air Conditioning equipment in Alberta.***

1. Describe how the B52 relates to the refrigeration and air conditioning installations.
2. Describe how the Canadian Code of Practice relates to the refrigeration and air conditioning installations.
3. Demonstrate how the B52 is used in determining minimum standards in a refrigeration and air conditioning install and maintenance work in industrial applications.
4. Demonstrate how the Canadian Code of Practice is used in determining minimum standards in a refrigeration and air conditioning install and maintenance work in industrial applications.

**SECTION TWO: ..... INTERMEDIATE HEATING THEORY ..... 13%**

**A. Electronic Ignition Systems ..... 37%**

**Outcome:      *Troubleshoot electronic ignitions and components found in HVAC equipment.***

1. Describe the operation of basic ignition systems used in mid and high-efficiency furnaces.
2. Describe the application and sequence of operation of electronic controls.

3. Interpret electrical schematic drawings.
4. Describe diagnostic techniques and routine maintenance requirements for electrical controls.

**B. Natural and Fan Assisted Draft Appliances..... 38%**

**Outcome: Install and service gas fired appliances, and conversion burners.**

1. Describe requirements of the types of burners used in natural and power assisted draft appliances.
2. Describe the operation and function of each type of burner.
3. Explain the relationship between fan speed and volume delivered.
4. Explain the relationship between volume delivered and static pressure.
5. Explain the selection requirements for fan units.
6. Describe the differences in fan location between natural, induced and forced.
7. Describe procedures for converting an appliance from one gas to another.
8. Describe regulations, applicable Gas Codes and as they apply to natural and fan-assisted draft appliances.
9. List and explain the safe light-up requirements for burners.

**C. Introduction to Make-Up Air ..... 25%**

**Outcome: Service make-up air units.**

1. Describe terminology used in make-up air units.
2. Describe components used in make-up air units.
3. Describe applications and limitations of make-up air components.
4. Describe designs of make-up air systems.

**SECTION THREE: ..... INTERMEDIATE ELECTRICAL THEORY ..... 14%**

**A. Three Phase Motors ..... 15-8%**

**Outcome: Service three phase motors on RAC equipment.**

1. Identify terms related to three-phase induction motor.
2. Describe the characteristics of mechanical loads.
3. Describe the construction of a three-phase induction motor.
4. Describe the principle of operation of a squirrel-cage induction motor.
5. Describe information located on a motor nameplate and calculate horsepower, motor efficiency and speed regulation.
6. Calculate rotor parameters including synchronous speed, slip and breakdown torque, and determine the effect that the percent slip has on rotor parameters.
7. Describe NEMA rotor designs A, B, C and D, and their electrical and mechanical characteristics.
8. Describe the wound-rotor motor and its electrical and mechanical characteristics.
9. Describe the relationship between torque and rotor electrical characteristics in a squirrel-cage induction motor.

**B. Motor Installations..... 41%**

**Outcome: Install motors in RAC systems.**

1. Describe motor installation methods.
2. Describe three phase motor connections.
3. Describe three phase motor starting methods.
4. Describe methods of reversing three phase motors.
5. Describe three phase motor protection.
6. Connect and analyze a three phase dual voltage motor connection.
7. Connect and analyze a three phase two speed motor connection.
8. Connect and analyze a three phase part winding motor connection.
9. Connect and analyze a three phase wye motor connection.
10. Connect and analyze a three phase delta motor connection.

**C. Variable Speed Drives (VSD)..... 24%**

**Outcome: Program, adjust and troubleshoot variable speed drives in RAC applications.**

1. Describe the principles of operation of ac induction in VSD motors.
2. Compare methods of speed control of ac induction motors.
3. Describe the principles of operation and application of a typical VSD.
4. Describe the principles of operation and application of a dc motor used with VSD.
5. Connect, program and troubleshoot a VSD.

**D. Diagrams ..... 17%**

**Outcome: Interpret electrical diagrams used in refrigeration and HVAC systems.**

1. Describe electrical diagrams used in refrigeration and HVAC systems.
2. Describe symbols and terminology used in refrigeration and HVAC systems.
3. Interpret diagrams for refrigeration and HVAC systems.
4. Draw electrical diagrams for a refrigeration and HVAC system.

**SECTION FOUR: ..... AIR HANDLING THEORY ..... 26%**

**A. HVAC Load Calculations, Design and Equipment Selection ..... 22%**

**Outcome: Calculate loads for HVAC systems, design and select equipment.**

1. Describe terminology and formulas used in HVAC load calculations.
2. Describe HVAC loads.
3. Describe short and long methods of load calculating.
4. Calculate HVAC load requirements.
5. Describe terminology and formulas used in system design and equipment selection.
6. Describe HVAC systems and equipment.
7. Describe equipment applications and limitations.
8. Select HVAC equipment components.



**B. Advanced Air Properties..... 16%**

**Outcome:** *Explain the properties of air as it relates to advanced air flow design.*

1. Describe terminology and formulas used in advanced air flow calculations.
2. Describe the psychrometric chart as it relates to air conditioning systems.
3. Identify the points and lines represented on a psychrometric chart.
4. Describe tools used for measuring air properties.
5. Measure and plot an HVAC system to determine its characteristics.
6. Describe troubleshooting techniques used for air handling equipment in HVAC systems.
7. Demonstrate troubleshooting techniques for air handling equipment in an HVAC system.

**C. Air Conditioning Systems..... 52%**

**Outcome:** *Apply knowledge of the principle operations of an air conditioning system in servicing RAC equipment.*

1. Describe terms associated with air conditioning systems.
2. Describe the components and their applications of comfort air conditioning systems.
3. Describe the components and their applications of year round air conditioning systems.
4. Describe the components and their applications of process air conditioning systems.
5. Analyze the operation of an air conditioning system.
6. Plot readings from an air conditioning system on a psychrometric chart.
7. Measure and analyze a residential split system.
8. Measure and analyze a commercial air conditioning system.
9. Measure and analyze a heat pump system.
10. Measure and analyze a process air conditioning system.

**D. Air Instruments and System Balancing ..... 10%**

**Outcome:** *Use air instruments to analyze and balance HVAC systems.*

1. Define terms used in air balancing.
2. Describe the tools and instruments used in system balancing.
3. Calculate air velocity and volumes using tables and charts.
4. Use air instruments to measure, analyze and balance a HVAC system.

**FOURTH PERIOD TECHNICAL TRAINING  
REFRIGERATION AND AIR CONDITIONING MECHANIC TRADE  
CURRICULUM GUIDE**

*UPON SUCCESSFUL COMPLETION OF THIS COURSE THE APPRENTICE SHOULD BE ABLE TO PERFORM  
THE FOLLOWING OUTCOMES AND OBJECTIVES.*

**SECTION ONE:.....ADVANCED REFRIGERATION THEORY..... 33%**

**A. Chillers..... 18%**

**Outcome:      *Service a chiller system.***

1. Define terms used with chiller systems.
2. Describe chiller system components and their applications.
3. Describe an absorption cycle.
4. Describe cooling towers and evaporative condensers.
5. Describe refrigerants specific to chiller systems.
6. Describe start-up and shut-down procedures of chiller systems.
7. List and identify cross connection control devices and describe their operation.
8. Observe a chiller and tower system in operation.
9. Observe a centrifugal chiller tear-down.

**B. Ultra Low Compressions Systems ..... 12%**

**Outcome:      *Service ultra-low compression systems.***

1. Define terms used in ultra-low compression systems.
2. Describe the components and their applications of ultra-low compression systems.
3. Describe the refrigerants specific to ultra-low compression systems.
4. Describe special precautions required in the installation and servicing of ultra-low compression systems.
5. Describe troubleshooting techniques used on ultra-low compression systems.
6. Operate and analyze an ultra-low compression system.

**C. Multiplex Systems ..... 20%**

**Outcome:      *Service multiplex systems.***

1. Define terms related to multiplex systems.
2. Describe the components and their applications of multiplex systems.
3. Describe the operation of multiplex systems.
4. Describe troubleshooting techniques used on multiplex systems.
5. Observe and analyze the operation of a multiplex system.

**D. Industrial Refrigeration Systems ..... 25%**

**Outcome:      *Service industrial refrigeration systems.***

1. Define terms related to industrial refrigeration systems.

2. Describe the components and their applications of industrial refrigeration systems.
3. Describe the operation of industrial refrigeration systems.
4. Describe troubleshooting techniques used on industrial refrigeration systems.
5. Observe and analyze the operation of an industrial refrigeration system.
6. Overhaul an industrial refrigeration compressor.

**E. Circulating Pumps..... 10%**

**Outcome: Service circulating pumps.**

1. Define terms related to circulating pumps.
2. Describe the components and their applications of circulating pumps.
3. Describe the operation of circulating pumps.
4. Describe troubleshooting techniques used on circulating pumps.
5. Calculate performance of a circulating pump using system curve and pump curve.
6. Observe and analyze the operation of a circulating pump.

**F. B52 Piping Codes and Canadian Code of Practice..... 5%**

**Outcome: Apply the B52 Mechanical Refrigeration Code and the Canadian Code of Practice to install Air Conditioning piping systems in Alberta.**

1. Describe how the B52 relates to the Refrigeration and Air Conditioning piping systems design and construction.
2. Describe how to use the practical hand book for implementing B52 code.
3. Describe how the Canadian Code of Practice relates to the Refrigeration and Air Conditioning piping systems design and construction.

**G. Advanced Drawing Interpretation..... 10%**

**Outcome: Interpret RAC drawings.**

1. Describe the process for developing a material takeoff list.
2. Develop a scale layout for refrigeration or HVAC system.
3. Compile a list of equipment.
4. Compile a list of supply materials.
5. Develop a material takeoff list from drawings.

**SECTION TWO: ..... ADVANCED HEATING THEORY..... 20%**

**A. Troubleshooting Gas Fired Equipment..... 21%**

**Outcome: Troubleshoot gas fired equipment.**

1. Describe problems associated with gas fired equipment.
2. Describe a systematic approach to troubleshooting gas fired equipment.
3. Troubleshoot and solve problems associated with gas fired equipment.

**B. Combustion Analysis ..... 17%**

**Outcome: Perform combustion analysis.**

1. Define terms associated with combustion analysis.
2. Describe tools and equipment used for combustion analysis.
3. Describe procedures used in combustion analysis.
4. Describe safety concerns associated with combustion analysis.
5. Perform combustion analysis.

**C. Advanced Make-up Air Systems ..... 33%**

**Outcome: Service make-up air systems.**

1. Describe auxiliary components of make-up air systems.
2. Describe control systems of make-up air units.
3. Describe burner operations of make-up air systems.
4. Describe cooling control systems of make-up air units.
5. Observe operation of a make-up air system.

**D. Troubleshooting Make-up Air Systems ..... 21%**

**Outcome: Troubleshoot make-up air systems.**

1. Describe problems associated with make-up air equipment.
2. Describe a systematic approach to troubleshooting make-up air equipment.
3. Commission and start-up a make-up air system.
4. Troubleshoot to solve problems associated with make-up air equipment.

**E. Workplace Coaching Skills ..... 8%**

**Outcome: Use coaching skills when training an apprentice.**

1. Describe the process for coaching an apprentice.

**SECTION THREE: ..... COMPLEX AIR SYSTEM THEORY ..... 17%**

**A. Complex HVAC Systems ..... 25%**

**Outcome: Service complex HVAC systems.**

1. Define terms used in complex HVAC systems.
2. Describe components and their applications in complex HVAC systems.
3. Describe methods used to control complex HVAC systems.
4. Describe designs of complex HVAC systems.
5. Describe the operation of complex HVAC systems.
6. Operate and analyze a complex HVAC system.

<b>B. Troubleshooting Complex HVAC Systems.....</b>	<b>30%</b>
<b>Outcome:     <i>Troubleshoot complex air conditioning systems.</i></b>	
1. Define problems associated with complex HVAC equipment.	
2. Describe a systematic approach to troubleshooting complex HVAC equipment.	
3. Describe maintenance procedures of complex HVAC equipment.	
4. Troubleshoot complex HVAC equipment.	
<b>C. Advance Mechanical Drives for Fan Systems.....</b>	<b>13%</b>
<b>Outcome:     <i>Service mechanical drives for fan systems.</i></b>	
1. Define terms used for advanced mechanical drives for fan systems.	
2. Describe components and their applications of mechanical drives for fan systems.	
3. Describe the properties of fan performance for fan systems.	
4. Describe maintenance and adjustment procedures of advanced mechanical drives for fan systems.	
5. Troubleshoot complex mechanical drive systems problems.	
<b>D. Installation of HVAC Equipment .....</b>	<b>20%</b>
<b>Outcome:     <i>Install and maintain HVAC equipment.</i></b>	
1. Define installation procedures used in installing HVAC units.	
2. Describe considerations of location and equipment when installing HVAC systems.	
3. Describe start-up and shut-down procedures of HVAC systems.	
4. Describe system maintenance procedures of HVAC systems.	
5. Demonstrate start-up and shut-down procedures of HVAC systems.	
<b>E. Energy Management Systems (EMS) and Indoor Air Quality .....</b>	<b>12%</b>
<b>Outcome:     <i>Service energy management systems to optimize indoor air quality.</i></b>	
1. Define terms used in EMS and indoor air quality.	
2. Describe the components and their applications of EMS and indoor air quality equipment.	
3. Describe designs and principles of EMS.	
4. Describe maintenance procedures of indoor air quality equipment.	
<b>SECTION FOUR: .....</b>	<b>ADVANCED CONTROL SYTEMS..... 30%</b>
<b>A. Specialized Electronic Control Systems.....</b>	<b>22%</b>
<b>Outcome:     <i>Install and maintain specialized electronic control systems.</i></b>	
1. Define terms used in specialized electronic control systems.	
2. Describe components and their applications of specialized electronic control systems.	
3. Describe programming methods of specialized electronic control systems.	
4. Describe design and application of specialized electronic control systems.	
5. Describe maintenance procedures of specialized electronic control systems.	
6. Connect and program a specialized electronic control system.	

**B. Electromechanical Control Systems ..... 17%****Outcome: Install and maintain electromechanical control systems.**

1. Define terms used in electromechanical control systems.
2. Describe components and their applications of electromechanical control systems.
3. Describe calibration methods of electromechanical control systems.
4. Describe design and application of electromechanical control systems.
5. Describe maintenance procedures of electromechanical control systems.
6. Connect and calibrate an electromechanical control system.

**C. Advanced Electrical Troubleshooting ..... 14%****Outcome: Maintain electrical components found in HVAC and refrigeration equipment.**

1. Identify problems associated with electrical components in HVAC and refrigeration equipment.
2. Describe a systematic approach to troubleshooting HVAC and refrigeration equipment.
3. Use advanced electrical schematic drawings in troubleshooting electrical problems in HVAC and refrigeration equipment.
4. Troubleshoot to solve problems associated with HVAC and refrigeration equipment.

**D. Schematic Diagrams ..... 14%****Outcome: Interpret schematic diagrams used in refrigeration and HVAC systems.**

1. Describe types of schematic diagrams used in refrigeration and HVAC systems.
2. Describe symbols and terminology used in refrigeration and HVAC schematic diagrams.
3. Interpret schematic diagrams for refrigeration and HVAC systems.
4. Draw schematic diagrams for a refrigeration and HVAC system.

**E. Economizer Controls and Accessories ..... 19%****Outcome: Service economizer controls and accessories.**

1. Define terms used with economizer controls and accessories.
2. Describe components and their application of economizer controls and accessories.
3. Describe calibration methods of economizer controls and accessories.
4. Describe retrofit techniques for economizer controls for HVAC systems.
5. Describe design and applications of economizer controls and accessories.
6. Connect and calibrate an economizer control system with accessories.

**F. New Environmental Technology ..... 11%****Outcome: Apply changing trends in environmental technology to upgrade RAC equipment.**

1. Define terms related to environmental technology as it relates to the HVAC and refrigeration industry.
2. Identify issues that relate to environmental technology as it relates to the HVAC and refrigeration industry.
3. Describe authorities having jurisdiction on environmental technology as it relates to the HVAC and refrigeration industry.

4. Identify legislation and codes as it relates to environmental technology for the HVAC and refrigeration industry.

**G. Interprovincial Standards Red Seal Program ..... 3%**

***Outcome: Use Red Seal products to challenge an Interprovincial examination.***

1. Identify Red Seal products used to develop Interprovincial examinations.
2. Use Red Seal products to prepare for an interprovincial examination.



# Apprenticeship and Industry Training

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