# SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY SAULT STE. MARIE, ONTARIO



#### **COURSE OUTLINE**

COURSE TITLE: Heating, Ventilation and Air Conditioning

CODE NO.: HMI 214 SEMESTER: FOUR

**PROGRAM:** Home Inspection Technician

**INSTRUCTOR:** Darryl Matthews

**DATE:** January **PREVIOUS OUTLINE DATED:** January

2016

2015

APPROVED: "Corey Meunier"

CHAIR

TOTAL CREDITS: 3

PREREQUISITE(S): HMI 202 Heat Transfer

HOURS/WEEK: 3

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#### I. COURSE DESCRIPTION:

This course applies concepts learned in HMI 202 to home heating, air conditioning and ventilation systems. We will be using air conditioning and refrigeration principles to help with the home inspector's role in defect recognition when examining a home's HVAC system. Students will also become familiar with types of heat pumps as well as their functions.

#### II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course, the student will demonstrate the ability to:

# 1. Demonstrate safe work practices as they relate to the air conditioning system and be able to identify these hazards.

Potential Elements of the Performance

- Understand the hazards and know the safety precautions to be used when handling refrigerants
- State the shop safety rules
- Discuss refrigerant recovery techniques
- Discuss how to safely use hand and power tools
- Name electrical hazards and discuss electrical safety rules
- Identify the physical and chemical hazards of an air conditioning system
- List types of refrigerant leak detection
- Describe MSDS's including content along with the WHMIS regulations

# 2. Understand the benefits that can be achieved through proper maintenance of HVAC equipment.

Potential Elements of the Performance:

- In the shop setting, measure and record the entering and leaving dry bulb temperatures
- Explain the fundamental principles of Psychrometrics
- List the reasons for evacuating a refrigeration system
- Describe the pressure-temperature relationship of saturated refrigerant
- Describe the fundamental principles of heat transfer as they apply to the water-cooled condensers, cooling towers, and evaporative condensers
- Identify the four major components of the air conditioning system and explain their operating functions.
- Describe how to safely and properly perform preventative maintenance on the air conditioning system.

 Discuss the importance of replacing the air filter on a regular basis

### 3. Demonstrate the ability to safely use selected tools, meters, and refrigeration equipment.

#### Potential Elements of the Performance:

- Identify the major tools used in HVAC/R work
- List the different types of electrical meters and explain how they are used
- Explain the relationship of voltage, current, and resistance in an electrical circuit
- Recognize the importance of properly sized wire for varying load requirements
- Distinguish the difference between the high side and low side of an air conditioning system
- In a lab setting, demonstrate the safe use of electrical meters and refrigeration gauges
- Understand the benefits of having a programmable thermostat control the air conditioning system.

# 4. Recognize the principles of operation of an air conditioning system.

#### Potential Elements of the Performance:

- Explain the fundamental principles of the refrigeration cycle
- Perform practical assignments in the lab environment and be able to put recognize and analyze the data
- Use examples when describing the three basic methods of heat transfer
- Discuss the difference between recovered, recycled, and reclaimed refrigerant
- Know how the properties of moist humid air relates to human comfort
- Explain why the suction line requires insulation on it.
- Identify how the first and second laws of thermodynamics apply to the air conditioning system
- Compare sensible heat to latent heat

# 5. Distinguish between the different types/styles of air conditioning systems.

#### Potential Elements of the Performance:

- Explain the operation of a ductless split air conditioning unit
- Describe the cooling and dehumidification process
- Compare the operation between an air cooled and water cooled condenser
- Understand the operation of fluid pressure in circulating pumps as they apply to geothermal operations
- State how a heat pump works
- Explain the operating function of the major components of an air conditioning system and heat pump system including: compressor, reversing valves, expansion valve, condenser coil and evaporator coils
- Understand that the efficiency of a system can change, depending on the physical size of a component

# 6. Explain how the ventilation system affects air distribution in air conditioning system.

#### Potential Elements of the Performance:

- Understand how airflow and air quantity are affected by fitting losses of the duct systems
- Be able to explain the effect of the equipment selection and operation will have on the humidity level of the air
- Explain the purpose of the condensate trap on the drain line from an air conditioning evaporator
- Explain the differences between static pressure and velocity pressure
- Recognize signs of poor airflow across a furnace or air conditioning system
- Interpret between the different styles of fans and explain their applications
- Comprehend the design considerations for locating duct runs
- Understand the benefits of proper thermostat location placement can have on a system

# 7. Identify the differences between Ground-Source, Air to Air, and Geothermal Heat Pumps

#### Potential Elements of Performance:

- Understand the operation of the heat pumps components
- Describe the applications best suited for air source and water source heat pumps
- Understand the considerations for sizing the water loop circulating pump.

- List the types of water loops for water source heat pumps
- Understand the characteristics of refrigerant as it flows through the air conditioning components in the heating and cooling modes
- Describe what happens to the refrigerant in the evaporator coil and condenser coil
- Explain how a geothermal system works
- Understand the environment that is necessary for an air conditioning unit and furnace to function properly

#### III. TOPICS:

- 1. Protect yourself and others using safe work practices
- 2. Principles of heat transfer
- 3. Electrical meters and troubleshooting
- 4. Understand how thermodynamic principles relate to heat transfer
- 5. Types of HVAC equipment
- 6. Ventilation requirements for an HVAC system
- 7. Refrigeration and heating cycle troubleshooting guides

#### IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

-Fundamentals of HVAC/R, Carter Stanfield and David Skaves; I Prentice Hall ISBN-10: 0-13-222367-8 I ISBN-13: 978-0-13-222367-6 -Handouts specific to course topics

#### V. EVALUATION PROCESS/GRADING SYSTEM:

Attendance	5%
Participation	10%
Theory test #1	15%
Theory test #2	15%
Theory test #3	15%
Practical project #1	20%
Practical project #2	<u>20%</u>
	100%

Unexcused late assignments reduces grade by three marks per day.

The following semester grades will be assigned to students:

Grade	<u>Definition</u>	Grade Point Equivalent
A+ A	90 – 100% 80 – 89%	4.00
В	70 - 79%	3.00
С	60 - 69%	2.00
D	50 – 59%	1.00
F (Fail)	49% and below	0.00
CR (Credit)	Credit for diploma requirements has been awarded.	
S	Satisfactory achievement in field /clinical placement or non-graded subject area.	
U	Unsatisfactory achievement in	
	field/clinical placement or non-graded subject area.	
X	A temporary grade limited to situations	
	with extenuating circumstances giving a	
	student additional time to complete the requirements for a course.	
NR	Grade not reported to Registrar's office.	
W	Student has withdrawn from the course	
	without academic penalty.	

#### VI. SPECIAL NOTES:

#### Attendance:

Sault College is committed to student success. There is a direct correlation between academic performance and class attendance; therefore, for the benefit of all its constituents, all students are encouraged to attend all of their scheduled learning and evaluation sessions. This implies arriving on time and remaining for the duration of the scheduled session.

#### VII. COURSE OUTLINE ADDENDUM:

The provisions contained in the addendum located on the portal form part of this course outline.

### HMI 214 HVAC

Week	Outcomes	Format	Hrs	Topic/Content	Readings	Assignment	Assessment	Resources
1	1,3	Lecture	3	Protect self and others:				Calculators,
				<u>Follow</u> shop safety rules and understand how				green tag
				practicing good housekeeping at all times				safety boots,
				prevents accidents				safety glasses
				Explain hazards associated with the different				Text book
				types of cooling systems.				Fundamentals
				Comprehend the safety procedures and Personal	Units 3, 23,			of HVAC/R
				Protective Equipment associated with the HVAC	26			
				industry.				Instructor
				Identify information on a Material Safety Data		End of chapter		handouts /
				Sheet		questions		training
				<u>Describe</u> the four classifications of fire				materials
				extinguishers				
				<u>Identify</u> unsafe situations and conditions.				
				<u>Understand</u> the fundamentals of the heating and				
				cooling systems, as well as, recognize the				
				environmental protection process of refrigerant				
				recovery systems				
2	1, 2	Lecture	1.5	Principles of Heat transfer and the effects these				As above
				have on a heating or cooling system:				
				<u>Understand</u> the principles of conduction,				
				radiation, convection, and evaporation.				
				Explain these principles and relate them to the			Formative	
				condition of heating and cooling equipment.				
				<u>Identify</u> , through observation and temperature	Section 2			
				readings, when equipment is functioning				
		_		properly.	Units 4-8			
		Lab	1.5	Take readings at strategic locations in the		Outline:	Observation	
				functioning cooling system and document		Project -	of students	
				findings for analysis		practical	in lab	
				<u>Understand</u> the differences between latent and		assignment #1		
				sensible heat as applied to a cooling system and				
				identify and calculate these values.				

3	2,4	Lab	3	Continuation of practical lab assignment #1  Lab project consists of taking temperature readings to understand that latent heat is removed from the house air and that the amount of condensation (drain) an air conditioner produces will be excessive.  Lab reports to be completed compiling the findings. Complete Practical Assignment #1.	Unit 23	Practical assignment #1	Observation of students in lab  Summary report of lab	As above
4	1,3	Lecture	1	Demonstrate the ability to identify the heating/cooling trade tools and meters  Describe and explain the purpose of various specialty tools such as: refrigeration gauges, flaring tools, vacuum pump, micron vacuum gauge, and electrical meters.  Understand how voltage, current, and resistance are part of a heating or cooling system  Practise using these tools while performing work related tasks on the equipment in the lab: e.g. checking refrigeration pressures, superheat, and sub-cooling.  Summarize their experiences in a report.	Section 3 Units 9-11 Unit 15, 27		Observation of students in lab  End of chapter questions	As above
5	3, 7	Test 1 Lab	1	Theory test #1 – 2 hrs  Lab time 1 hr  Continuation of Trade tools and meters: Demonstrate an understanding of electrical fundamentals as it relates to the heating and cooling systems.  Identify the condition of brittle and damaged wiring on various heating and cooling equipment and comprehend the amperage to wire size (gauge) ratio	Test Units 1-11 Section 3, 5 Units 11-14	Practical assignment #1 due  Test 1	Observation of students in lab  Summative Theory test 1	As above

6	4		3	Take amperage readings of a motor load safely State the reasons why 208V appliances run at lower amperages than 110V appliances Identify wiring alterations that may have been made to equipment.  Field trip Location to be determined		Field trip	As above
7	4	Lecture	2	Review and discuss the field trip. Understand the operation of an evaporator, condenser, compressor, and metering device. Take temperatures at various points along the piping of the air conditioner and explain what is happening to the physical state of the refrigerant.  Explain thermodynamic terminology such as: British Thermal Unit, Joule and Watt. Become familiar with terminology related to the First and Second Laws of Thermodynamics.  Describe what occurs during the latent heat of fusion and latent heat of vaporization.  Lab - study the role that airflow and filter maintenance have on heating or cooling operations.  Locate the high and low sides of an air conditioning system Perform temperature readings at various locations to identify deficiencies.	Section 2 Units 17-22	Observation of students in lab  End of chapter questions	As above
8	4, 5	Lecture	1	Explain the basic heat transfer principles of operation for the various heating and cooling sources.  Identify various energy sources and explain their operations with confidence.		Observation of students in lab  Formative assessment	As above

				<u>Understand</u> the refrigeration principles and heat transfer concepts and use those ideas to describe	Section 4, 5			
		Lab	2	one particular system to their client  Describe and determine if unacceptable alterations have been made between the size of the duct system and the BTU capacity of the piece of equipment, including supply plenum of furnaces, return air drops and branch runs.  Lab assignment: Outline the pros and cons for each application explained in week 10, explaining answers.	Unit 23, 27	Lab assignment		
9	4, 5, 6	Lab	3	Explain the basic principles of operation for air conditioning system components.  Understand how a ductless split air conditioning system works  Review the differences between recovered, recycled, and reclaimed refrigerant  Explain the concept called entropy, enthalpy and practice using a psychometric chart.  Lab -work continued: perform a variety of procedures to the equipment and understand what the results of the tests indicate.	Section 4, 5 Unit 18 Instructor handouts	Practical Assignment 2 given	Observation of students in lab	As above
10			3	Test #2 - 3 hours		Theory Test # 2	Summative	As above

11	6	Lecture	3	Review previous HMI 202 course materials		Formative	As above
				referring to the safe and successful ignition of		assessment	
				gas fired equipment.	Section 6		
				Examine the in-depth operation of a fuel burning			
				appliance and its components.	Unit 37-40	End of	
				Explain how the size of the furnace plenum, duct		chapter	
		Lab		system and return air duct affects the operating		question	
				efficiency of the equipment			
				<u>Understand</u> that temperature differences are			
				critical to the efficient operation of the unit.			
				Explain where to take temperature readings and			
				transfer resultant values into an efficiency rating			
				for how the system is functioning.			
				<u>Describe</u> the important role that a properly			
				installed humidifier has on a heating system and			
				the importance of dehumidification in the			
				summer time			

12	6	Lecture	3	Describe the duties of a ventilation system and explain the primary function.		Observation	As above
		Lab		Realize the variables that determine the size of a duct run and difference between static and	Section 7	of students in lab	
				velocity pressure of air	Unit 66-69		Instructor
				<u>Understand</u> the purpose of a condensate trap on	la atau sata a		handouts
				an evaporator.  Know where to properly locate a thermostat	Instructor Handouts	End of	
				Become familiar with the different kinds of	Tianaouts	chapter	
				ventilation fans		questions	
				state the concepts of how an HRV operates		.	
13	6, 7	Lecture	3	Identify the differences between Ground Source,			As above
				air to air, and geo-thermal heat pumps		Observation	
		Lab		<u>Understand</u> what the main components of heat	Section 6		
				pump systems are and be able to explain the	Unit 49-53	End of	
				operations		chapter	
				Identify the roll a circulating pump serves in a		questions	
				geo-thermal heat pump  Describe the main differences between styles of			
				heat pumps.			
				State the importance of a circulating pump			
				Work on completing assignment #2 in the lab			
				Review materials for upcoming test			
14		Test #3	3	Theory Test #3 - 3 hrs		Summative	Pencils, calculator, eraser
15	1-7	Lecture		Review highlights from previous Learning	Instructor		
		Lab	3	Outcomes	Handouts		
16		Lecture		Question and answer session		Formative	
			3	Class to evaluate my instruction by completing			
				an evaluation			
				Debrief of the semester			