

Outcomes Mapping

Technology & Health Division

Program:	Air Conditioning and Refrigeration	# Courses: (if applicable)	11	Updated:	6/29/2015	Submitted by:	Darrow Soares
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Institutional Level Outcomes (ILOs): *As a result of an educational experience with any aspect of the college, students will develop the following knowledge, skills, abilities, and attitudes:*

1. Communication	2. Critical Thinking	3. Information and Technology Literacy	4: Personal, Social, Civic, & Environmental Responsibility			
Connect PLOs with an I , P , or M (see Key in Footer) identifying the level to which knowledge or a skill can be demonstrated following the completion of the program or educational experience.			PLO to ILO Alignment			
PLO Name	PLO Defined: Upon successful completion of this program, students will be able to:	1	2	3	4	
1. Refrigerant handling	Properly handle refrigerants based on Section 608 of the clean air act.	p			M	
2. Evaluation of air conditioning and refrigeration systems	Evaluate, troubleshoot, and modify the electrical, mechanical and air side operation of an air conditioning or refrigeration system.	P	P			
3. Air conditioning equipment selection	Perform a residential heat load calculation, select the equipment, and size the ductwork based on ACCA's Manual J8 and Manual D.		P	P		
4. Refrigeration equipment selection	Select equipment and components for commercial refrigeration systems.		p	p		

See the Outcomes Assessment website for definitions and examples of Mt. SAC's ILOs: <http://www.mtsac.edu/instruction/outcomes/ilos.html>

Key for Level of Learning

(Use for Mapping SLOs/MOs to PLOs to ILOs)

I = Knowledge/Skill Introduced

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Outcomes Mapping

Student Learning Objectives (SLOs), Measureable Objectives (MOs), Administrative Unit Objectives (AUOs)														
Course: AIRC 10	Connect Outcomes with an I, P, or M (see Key in Footer) identifying the level to which knowledge or a skill can be demonstrated in that portion of the course or service.													
SLOs, MOs, AUOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	ILO 1	ILO 2	ILO 3	ILO 4
AIRC 10. Course completers will be able to determine the correct refrigerant charge of a non-critcally charged system based on receiver design.	M										I	I	I	M
AIRC 10. Course completers will apply Fan Laws to assess and successfully adjust air flow		P									I	I		
Apply the appropriate mathematical process to solve air conditioning and refrigeration problems.	P											I		
Apply the appropriate mathematical process to solve air conditioning and refrigeration problems.	P											I		
Solve for and interpret percent, equivalents of decimals, and fractions.												I		
Interpret functions of equations applied to mathematical problems.												I		
Analyze, express, and solve problems with equations.	I											I		
Solve problems involving direct and indirect proportion.		P										I		

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Course: AIRC 11	Connect Outcomes with an I, P, or M (see Key in Footer) identifying the level to which knowledge or a skill can be demonstrated in that portion of the course or service.													
SLOs, MOs, AUOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	ILO 1	ILO 2	ILO 3	ILO 4
Course completers will safely operate welding equipment	P													
Course completers will successfully join refrigerant lines.	P													I
Apply the principles of metallurgy related to the welding trades.														
Develop a vocabulary of terms and conditions related to the welding trade.											I			
Compare and contrast the different processes used to join similar and dissimilar metals.	I										I	I		
Demonstrate the principle of "sterile technique" in joining refrigerant lines.	I													
Choose the proper process to fabricate fittings related to air conditioning and refrigeration.	I											I		
Evaluate time requirements to fabricate or weld fittings for air conditioning and refrigeration.	I											I		
Integrate welding safety practices into work processes.	I										I	I		

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Course: AIRC 12	Connect Outcomes with an I, P, or M (see Key in Footer) identifying the level to which knowledge or a skill can be demonstrated in that portion of the course or service.													
SLOs, MOs, AUOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	ILO 1	ILO 2	ILO 3	ILO 4
Course completers will understand the structure and organization of the Uniform Mechanical Code											I	P	I	I
AIRC 12 course completers will be able to apply bullding codes to the installation of air conditioning and refrigeration equipment.											I	P	I	
Recognize the necessity for codes and standards.		P										I	I	
Describe the permit and inspection process.		P	I								I	I	I	
Research installation requirements for a fuel gas heating system based on the California Mechanical Code.		P	I									I	I	
Assess the installation of a fuel gas heating system based on the California Mechanical Code.		P										I	I	
Research installation requirements based on the National Electrical Code.		P										I	I	
Assess installations based on the National Electrical Code.		P	I									I	I	
Research the installation requirements for duct work based on the California Mechanical Code.		P	I									I	I	
Assess installations of duct work based on the California Mechanical Code.		P	I										I	

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Course: AIRC 20	Connect Outcomes with an I, P, or M (see Key in Footer) identifying the level to which knowledge or a skill can be demonstrated in that portion of the course or service.													
SLOs, MOs, AUOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	ILO 1	ILO 2	ILO 3	ILO 4
AIRC 20 course completers will properly handle refrigerants	M										P	I		M
AIRC 20 course completers will evaluate the mechanical operation of an air conditioning system.	P	P									P	P		
Construct mechanical air conditioning or refrigeration systems, set pressure switches and controls, identify the state of refrigerant at each point, and predict operating characteristics.		P	I	I								I		
Assess the operation of heat pumps based on gauge readings and measured sensible temperatures.		P									P	P		
Apply a deep vacuum to refrigeration systems in order to remove contaminants and check for refrigerant leaks.	P													
Charge and recover refrigerant from operational refrigeration systems.	P											I		P
Demonstrate the procedure for handling and containing refrigerants outlined in Section 608 of the Clean Air Act.	M										P	I		P
Explain how refrigerants used in the air conditioning and refrigeration industry cause ozone depletion and global warming.	P										P	I		P

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Course: AIRC 25	Connect Outcomes with an I, P, or M (see Key in Footer) identifying the level to which knowledge or a skill can be demonstrated in that portion of the course or service.													
SLOs, MOs, AUOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	ILO 1	ILO 2	ILO 3	ILO 4
AIRC 25 Course completers will understand the electrical sequence of operation for a five ton air conditioning system.											P	P		
Course completers will successfully use electrical meters commonly used in the Air Conditioning and Refrigeration industry.											P	P		
Compare and contrast the electrical designs and operation of air conditioning, refrigeration systems and heat pumps.		P		P								P		
Demonstrate the electrical operation and application of electro-mechanical components.		P		P								P		
Demonstrate the electrical operation of induction motors.		P		P								P		
Design electrical schematic diagrams.		P		P								P		
Assemble air conditioning systems, refrigeration systems and heat pumps from schematics.		P		P								P		
Evaluate electrical malfunctions in air conditioning, refrigeration systems and heat pumps.		P		I								P		

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Course: AIRC 26	Connect Outcomes with an I, P, or M (see Key in Footer) identifying the level to which knowledge or a skill can be demonstrated in that portion of the course or service.													
SLOs, MOs, AUOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	ILO 1	ILO 2	ILO 3	ILO 4
AIRC 26b course completers will correctly evaluate the sequence of operation for a high efficiency furnace		P	I								I	P		
AIRC 26B course completers will properly evaluate furnace installations		P	I								I	P	I	P
Illustrate the construction of a basic standard efficient furnace. Include the basic components for combustion and heat transfer to occur in addition to air flow for circulating air and the source and flow of combustion air.		P	I								I	P		
Estimate the efficiency of three furnaces based on the flue gas temperature of each system.		P										P		
Analyze the combustion process of three furnaces. Determine if combustion is complete and make the necessary adjustments to achieve a neutral burner flame.		P										P		
Determine air flow through a furnace based on the temperature rise across the heat exchanger. Verify your results by clocking the gas meter and applying the sensible heat formula.		P									I	P		

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Course: AIRC 30	Connect Outcomes with an I, P, or M (see Key in Footer) identifying the level to which knowledge or a skill can be demonstrated in that portion of the course or service.													
SLOs, MOs, AUOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	ILO 1	ILO 2	ILO 3	ILO 4
Course completers will properly select air conditioning equipment			P								I	P		I
AIRC 30 course completers will properly conduct a Heat Load calculation			P								I	P		I
Identify the factors that affect heat gain and heat losses for residential structures.			P								I	P	I	
Apply the format of Manual J as developed by the Air Conditioning Contractors Association to calculate heat losses and gains required for air conditioning systems.			P									P	I	
Establish the required cooling capacities for residential applications.		I	P									P		
Demonstrate an understanding of duct sizing calculators.		I	P								I	P		
Design and illustrate duct systems.			P								I	P		

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Course: AIRC 31	Connect Outcomes with an I, P, or M (see Key in Footer) identifying the level to which knowledge or a skill can be demonstrated in that portion of the course or service.													
SLOs, MOs, AUOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	ILO 1	ILO 2	ILO 3	ILO 4
Completers will understand electrical sequence of operations of commercial refrigeration equipment.		P									I	P		
Students will monitor proper phasing for 3 phase power		P										P		
Wire on/off circuitry for commercial compressors.		P										P		
Wire wye and delta three phase motors and transformers.		P										P		
Design wiring schematics for a common commercial water chiller.		P									I	P		
Wire Drives to power sources and respective motors.		P										P		
Program various aspects of Drives for performance and efficiency.		P									I	P		

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Course: AIRC 32a	Connect Outcomes with an I, P, or M (see Key in Footer) identifying the level to which knowledge or a skill can be demonstrated in that portion of the course or service.													
SLOs, MOs, AUOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	ILO 1	ILO 2	ILO 3	ILO 4
Course completers will be able to determine make-up air requirements for various commercial applications		P	P								P	P	I	
AIRC 32a course completers will evaluate the operation of an air conditioning system based on the treatment of air across the evaporator.		P	P								P	P	I	
Evaluate and analyze the Psychometric Chart		P	P								P	P	I	
Solve capacity of an air conditioning system based on air flow and psychrometrics		P	P								P	P	I	I
Assess the operation of an air conditioning system		P									P	P	I	
Compare operational fan performances utilizing fan laws		P	P								P	P	I	
Calculate pulley diameters		P	P								P	P	I	

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Course: AIRC 34	Connect Outcomes with an I, P, or M (see Key in Footer) identifying the level to which knowledge or a skill can be demonstrated in that portion of the course or service.													
SLOs, MOs, AUOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	ILO 1	ILO 2	ILO 3	ILO 4
AIRC 34 course completers will evaluate the operation of a commercial refrigeration system		P									P	P	P	I
AIRC 34 course completers will modify the operation of a commercial refrigeration system.	M	P									P	P		I
Analyze the operation of refrigeration or air conditioning systems based on applying the refrigeration cycle to a pressure- enthalpy chart.		P		P							P	P		I
Determine the causes of refrigerant side malfunctions based on condensing temperatures, evaporator temperatures, and superheat and sub cooling sensible temperatures.		P									P	P		
Adjust refrigeration pressure controls to manipulate fixture temperatures, evaporator temperatures, condensing temperatures, and capacity controls.		P									P	P		
Identify and apply common evaporator defrost methods to medium and low temperature refrigeration systems.		P									P	P		
Select refrigeration equipment and components for a given application based on manufacturer's performance data.		P		P							P	P	P	I

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Calculate the balance point of refrigeration components selected from performance data to determine overall system capacity.		P		P								P		I
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Student Learning Objectives (SLOs), Measureable Objectives (MOs), Administrative Unit Objectives (AUOs)														
Course: AIRC 95	Connect Outcomes with an I, P, or M (see Key in Footer) identifying the level to which knowledge or a skill can be demonstrated in that portion of the course or service.													
SLOs, MOs, AUOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	ILO 1	ILO 2	ILO 3	ILO 4
Apply classroom practices to practical applications in the air conditioning and refrigeration industry.	P	P	P	P							P	P		
Apply classroom procedures to maintain the mechanical operation of air conditioning and refrigeration equipment.	P	P	P	P							P	P		
Apply classroom theory and laboratory practices to practical applications in the air conditioning and refrigeration industry.	P	P	P	P							P	P		
Identify the procedures to maintain mechanical operation of air conditioning and refrigeration equipment. Develop and demonstrate the effect to maintain mechanical operation of air conditioning and refrigeration equipment.	P	P	P	P							P	P		
Analyze and solve common electrical, mechanical, and design problems encountered		P	P	P							P	P		

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in the field based on theoretical and laboratory experiences.														
Evaluate the performance of air conditioning and refrigeration equipment.		P	P	P								P	P	
Identify and analyze the causes and effects of equipment failures in the air conditioning and refrigeration industry.		P	P	P								P	P	

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