



AIR CONDITIONING TECHNOLOGY

Program of Studies
2015-2016



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Air Conditioning Technology

Course Title	Post-Secondary Connection	Valid Course Code	Recommended Grade Level				Recommended Credit
			9	10	11	12	
Commercial Refrigeration	ACR 200/201	470211	X	X	X	X	1
Cooling and Dehumidification	ACR 250/251	460824	X	X	X	X	1
Co-op (Air Cond)	ACR 299	460880				X	1
Electrical Components	ACR 130/131	460826	X	X	X	X	1
Green Awareness/Energy Management		460806		X	X	X	1
Heat Load/Duct Design	ACR 170	480812	X	X	X	X	1
Heat Pump Application	ACR 270/271	460801		X	X	X	1
Heating and Humidification	ACR 260/261	460820		X	X	X	1
HVAC Electricity	ACR 102/103	460817	X	X	X	X	1
Ice Machines	ACR 210	460845		X	X	X	1
Industrial Safety	ISX 100	499930	X	X	X	X	.5
Internship (Air Cond)	ACR 198	460883			X	X	1
Journeyman Preparation	ACR 290	460846		X	X	X	.5
Refrigeration Fundamentals	ACR 100/101	460828	X	X	X	X	1
Residential Energy Auditor Prep		460804		X	X	X	1
Sheet Metal Fabrication	ACR 112/113	460847		X	X	X	1
Special Problems (Air Cond)		460877		X	X	X	1

AIR CONDITIONING TECHNOLOGY

Program Description

Construction Technology; Heating Ventilation Air Conditioning and Refrigeration (HVACR) will incorporate classroom theory and hands-on laboratory experiences in industrial areas such as heat generation, ventilation, air-conditioning and refrigeration systems. The course will also present a history of building construction in the Heating and Cooling trade, with emphasis on future trends and construction careers.

Students will gain practice in the operation, maintenance and safety of various HVACR trade specific tools. Training in personal and jobsite safety in areas such as hand and power tools, ladders and scaffolding, electrical, and refrigerants/pressured gases is also included. Students are required to develop a layout of an air conditioning duct system and fittings. Proper use of hand tools and shop equipment is required to fabricate and install duct systems and fittings.

The course introduces fundamentals applicable to the heating phase of air conditioning including types of units, parts, basic controls, functions and applications. Emphasis is placed on practices, tool and meter use, temperature measurement, heat flow, the combustion process and piping installation practices. The basic sequence of operation for gas, oil, and electric furnaces is covered.

Included is an introduction to compression systems used in mechanical refrigeration including the refrigeration cycle, thermodynamic principles, and system components. Subjects covered include safety procedures, proper use of tools for installing and servicing refrigeration equipment, refrigerant charging and recovery, system evacuation, calculating superheat and sub cooling, and using a refrigerant temperature/pressure chart.

Students will use mathematical principles to solve heating and cooling problems and to troubleshoot HVACR issues. Students will also identify and interpret health, safety, and welfare standards and codes as dictated by local, state, and/or Federal agencies.

Environmental Protection Agency (EPA) Section 608 is offered as part of the program towards Career Readiness.

SAMPLE: CAREER PATHWAY- Air-Conditioning Technology

KENTUCKY CAREER PATHWAY/PROGRAM OF STUDY 2015-2016

COLLEGE/UNIVERSITY:		College / State University KCTCS Community College			CLUSTER:		Construction			
HIGH SCHOOL (S):		KY ATC/CTC/High School			PATHWAY:		Domestic Air Conditioner & Furnace Installer / Refrigeration Mechanic			
PROGRAM:		Air Conditioning Technology								
GRADE	ENGLISH	MATH	SCIENCE	SOCIAL STUDIES	REQUIRED COURSES			CREDENTIAL CERTIFICATE DIPLOMA DEGREE	SAMPLE OCCUPATIONS	
					RECOMMENDED ELECTIVE COURSES OTHER ELECTIVE COURSES CAREER AND TECHNICAL EDUCATION COURSES					
SECONDARY	9	English I	Algebra I	Earth Space Science	World History	Health and PE	ACR 100 Refrigeration Fundamentals	ACR 130 Electrical Components		
	10	English II	Geometry	Biology I	World Civics	History and Appreciation of Fine Arts	ACR 170 Heat / Duct Design 480812	ACR 120 HVAC Electricity 46017		
	11	English III	Algebra II	Physics or Chemistry	U.S. History	Foreign Language	ARC 250 Cooling & Dehumidification 470049	ARC 270 Heat Pump Application 46004	NCCER HVAC Level 1	HVAC Assistant
	12	English IV	Math Elective	Computer Aided Drafting (elective)	World Geography	ACR 200 Commerical Refrigeration 470211	Internship (Air cond) 460883	Co-op 1 (air cond.) 460880		Refrgeration Mechanic
POSTSECONDARY	Year 13	ENG 101 Writing I	MT 110 Applied Mathematics	ASTR 104 Astronomy	College Chemistry	PSY 100 Intro Psychology	ARC 208 Chillers	Occupation Safety	Refrigeration Mechanic	Industry Apprenticeship
	Year 14	ENG 200 Intro/Literature	Math 200	WLD 221 Certification Lab	HIS 109 US History	CAR 140 Surveying & Foundations	Materials Science	ACR 207 Commercial HVAC Systems	Associates Degree in Applied Science	HVAC Foreman / Manager
	Year 15	ENG 200 Intro/Literature	MAT 250 CALCULUS	PHY 236 UNIV. PHYSICS I	CIV 102 WORLD CIV. II	PHY 195 METHODS OF ENG. PHYSICS	CIV. II	CAD 200 Intermediate Computer Aided design		
	Year 16	PHY 140 INTRO. COMPUTING APPS.	MAT 308 CALCULUS II	PHY 259 STATICS	MAT 309 CALCULUS III	MAT 411 DIFFERENTIALS	TECHNICAL	PHY 330 DYNAMICS		
	Year 17	PHY 344 FLUID MECHANICS	PHY 370 INTRO. MODERN PHYSICS	CHE 201 GEN. COLLEGE CHEM. I	HUM 211 HUMANITIES	ITD 102 CAD APPLICATIONS	PHY 346 HEAT TRANSFER	PHY 375 MATERIALS SCIENCE	PHY 390 ENGR. MEASUREMENT	TECH.ELECTIVE
Year 17	PHY 359 MECHANICS OF MATERIALS	PHY 470 OPTICS	PHY 498 SENIOR ENGR. DESIGN I	ECO 231 PRINC. OF MICROECONOMICS	PHY 499 SENIOR ENGR. DESIGN II	TECHNICAL ELECTIVE	MAT DEPTH ELECTIVE	FREE ELECTIVE	HUM/FA ELEC.	
							BACHELORS DEGREE ENGINEERING	Western Kentucky UNIVERSITY	ENGINEER	
Other Elective Courses Career and Technical Education Courses Credit-Based Transition Programs (e.g. Dual/Concurrent Enrollment, Articulated Courses, 2+2+2) (◆=High School to Comm. College) (● =Com. College to 4-Yr Institution) (■ = Opportunity to test out) Mandatory Assessments, Advising, and Additional Preparation TECHNICAL COLLEGE CREDIT GIVEN THROUGH THE KCTCS DUAL ENROLLMENT PROGRAM Certificate given through the Warren County Area Technology Center Degree given through the Bowling Green Technical College KCTCS DEGREE GIVEN THROUGH THE MURRAY STATE UNIVERSITY										

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**AIR CONDITIONING TECHNOLOGY CAREER PATHWAYS
2015-2016**

**DOMESTIC AIR CONDITIONER AND FURNACE INSTALLER
CIP 47.0201.03**

PATHWAY DESCRIPTION: A program that prepares individuals to apply technical knowledge and skills to repair, install, service and maintain the operating condition of heating, air conditioning, and refrigeration systems. Includes instruction in diagnostic techniques, the use of testing equipment and the principles of mechanics, electricity, and electronics as they relate to the repair of heating, air conditioning and refrigeration systems.

BEST PRACTICE CORE

**EXAMPLE
ILP-RELATED
CAREER TITLES**

*Foundational Skills Necessary for Career-Ready Measure:
(KOSSA/Industry Certification)*

*Complete (2) **TWO CREDITS** from the following:*

- 460828 Refrigeration Fundamentals
- 480812 Heat Load/Duct Design

*Choose (2) **TWO CREDITS** from the following:*

- 460826 Electrical Components
- 460824 Cooling and Dehumidification
- 460820 Heating and Humidification
- 460801 Heat Pump Application
- 460880 Co-op I (Air Cond) OR 460883 Internship (Air Cond)

Construction Laborer
Construction Manager
Construction
Tradesperson
Environmental
Engineer
Solar Energy Tech
Home Inspector
Energy Auditor

AIR CONDITIONING TECHNOLOGY CAREER PATHWAYS 2015-2016

REFRIGERATION MECHANIC CIP 47.0201.04

PATHWAY DESCRIPTION: A program that prepares individuals to apply technical knowledge and skills to repair, install, service and maintain the operating condition of heating, air conditioning, and refrigeration systems. Includes instruction in diagnostic techniques, the use of testing equipment and the principles of mechanics, electricity, and electronics as they relate to the repair of heating, air conditioning and refrigeration systems.

BEST PRACTICE CORE

EXAMPLE ILP-RELATED CAREER TITLES

*Foundational Skills Necessary for Career-Ready Measure:
(KOSSA/Industry Certification)*

*Complete (3) **THREE CREDITS:***

- 460828 Refrigeration Fundamentals
- 460817 HVAC Electricity
- 460845 Ice Machines

*Choose (1) **ONE CREDIT** from the following:*

- 460826 Electrical Components
- 470211 Commercial Refrigeration
- 460824 Cooling and Dehumidification
- 460880 Co-op I (Air Cond) OR 460883 Internship (Air Cond)

Construction Laborer
Construction Manager
Construction
Tradesperson
Environmental
Engineer
Solar Energy Tech
Home Inspector
Energy Auditor

**AIR CONDITIONING TECHNOLOGY CAREER PATHWAYS
2015-2016**

**ENVIRONMENTAL CONTROL SYSTEM SERVICER ASSISTANT
CIP 47.0201.05**

PATHWAY DESCRIPTION: A program that prepares individuals to apply technical knowledge and skills to repair, install, service and maintain the operating condition of heating, air conditioning, and refrigeration systems. Includes instruction in diagnostic techniques, the use of testing equipment and the principles of mechanics, electricity, and electronics as they relate to the repair of heating, air conditioning and refrigeration systems.

BEST PRACTICE CORE

**EXAMPLE
ILP-RELATED
CAREER TITLES**

*Foundational Skills Necessary for Career-Ready Measure:
(KOSSA/Industry Certification)*

*Complete (1) **ONE CREDIT:***

- 460828 Refrigeration Fundamentals

*Choose (3) **THREE CREDITS** from the following:*

- 460817 HVAC Electricity
- 460826 Electrical Components
- 460824 Cooling and Dehumidification
- 460801 Heat Pump Application
- 460820 Heating and Humidification
- 460880 Co-op I (Air Cond) OR 460883 Internship (Air Cond)

Construction Laborer
Construction Manager
Construction
Tradesperson
Environmental
Engineer
Solar Energy Tech
Home Inspector
Energy Auditor

COMPLIMENTARY OR ADVANCED COURSEWORK BEYOND AIRCONDITIONING TECHNOLOGY PATHWAY(s)
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Upon completion of a pathway, additional coursework to enhance student learning is encouraged.
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Credits earned in Advanced or Complimentary Coursework “Beyond the Pathway” may not be substituted for pathway courses in order to achieve Preparatory or Completer status.

460806 Green Awareness/Energy Management
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499930 Industrial Safety (.5 credit)

460846 Journeyman Preparation (.5 credit)

460804 Residential Energy Auditor Prep
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460847 Sheet Metal Fabrication

460801 Heat Pump Application

460877 Special Problems (Air-Conditioning)
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Career Options

JAG Courses

Commercial Refrigeration

470211

Course Description		
<p>Develops techniques for servicing and troubleshooting mechanical and electromechanical refrigeration components. Electrical and refrigeration safety are emphasized. Proper tool use and environmentally sound refrigerant handling are taught.</p>		
Content/Process		
1	<p>Safety:</p> <p>a) Practice/observe safety practices/procedures</p>	
2	<p>Metering Devices:</p> <p>a) Define types of metering devices: capillary tubes, TXV, AEV, low side float, high side float, hand expansion valve, restrictor orifices</p> <p>b) Evaluate system performance when using different types of flow control devices</p> <p>c) Adjust and size devices when and where appropriate</p> <p>d) Verify system operation</p>	
3	<p>Compressors and Compression:</p> <p>a) Identify types of compressors: hermetic, open type, and semi-hermetic</p> <p>b) Identify methods of compression: centrifugal, rotary, screw, scroll, and reciprocating</p> <p>c) Select the compressor based on cooling load</p> <p>d) Explain the methods of compression</p> <p>e) Explain methods of unloading cylinders (capacity control)</p>	
4	<p>System Components and Accessories:</p> <p>a) Determine the system balance based on the selected components</p> <p>b) Properly identify the location of all accessories in a refrigeration system</p> <p>c) Determine appropriate accessories for systems application</p> <p>d) Explain the operation of the accessories in a refrigeration system</p> <p>e) Adjust EPR valve</p> <p>f) Check the CPR valve</p>	
5	<p>Piping:</p>	

	<ul style="list-style-type: none"> a) Calculate pressure drop in liquid line risers b) Size double risers c) Size hot gas line d) Size liquid line from condenser to receiver e) Explain the multiplex system f) Explain the cascade system g) Determine capacities of refrigerant lines h) Determine equivalent lengths of fittings i) Calculate total effective length of pipe runs 	
6	<p>Trouble Shooting and Service</p> <ul style="list-style-type: none"> a) Explain how to set superheat on a multiplex system b) Explain the heat reclaim cycle (three way valve) c) Explain the head pressure control system (flooded condenser) d) Adjust EPR valve e) Check control circuits according to manufacturer's specifications f) Check system for full refrigerant charge g) Explain the difference between medium temperature, low temperature, and ultra-low temperature storage systems h) Explain the operation of: air screen freezer, glass door freezer, and coffin cases i) Explain the different methods of defrost: electric resistance, hot gas, and cool gas j) Replace anti-sweat heaters k) Replace fan motors and fans l) Check and/or replace fan relay m) Verify air flow n) Demonstrate good customer relations o) Read electrical wiring diagrams and demonstrate understanding of wiring diagrams p) Develop a systematic way to diagnose system problems and demonstrate in class q) Determine cause of failure in system components r) Identify and describe possible causes of failure and how to eliminate causes s) Demonstrate use of tools and test equipment while following safety practices t) Verify system operation u) Write service report 	
<p>Connections:</p> <ul style="list-style-type: none"> *Secretary's Commission on Achieving Necessary Skills (SCANS) *National Center for Construction Education Research (NCCER) *21st Century Skills *Common Core State Standards ELA and Math *Interdisciplinary Course 		

Cooling and Dehumidification

460824

Course Description		
<p>Explains the working characteristics of air conditioning units with air and water cooled condensers. Line, low voltage and pneumatic controls will also be covered. ARI - Air Conditioning Systems: Subtopics A-E; System Installation and Start-Up: Subtopic D; System Servicing and Troubleshooting: Subtopic D; Controls: Subtopic</p>		
Content/Process		
1	<p>Safety:</p> <ul style="list-style-type: none"> a) Practice/observe safety procedures/techniques b) Explain the importance of manufacturers' installation and operation requirements c) Check system operation while following all safety procedures d) Follow local codes and ordinances during installation and repair e) Demonstrate the use of tools and test equipment while following safety practices 	
2	<p>Air-Conditioning:</p> <ul style="list-style-type: none"> a) Describe "air conditioning" b) List the benefits of "conditioned" air c) Describe some of today's current issues regarding air conditioning - industry concerns and future ramifications d) Describe the difference between "split systems" and "package systems" e) Describe the sequence of the basic refrigeration cycle and operation of the air conditioning system f) Use and read various tools and instrumentation needed for checking, testing, and operating air conditioning systems g) Analyze air conditioning systems and appropriately diagnose the electrical and/or mechanical problems 	
3	<p>Cooling and Dehumidification:</p> <ul style="list-style-type: none"> a) Define the types of condensers: air cooled, water cooled, evaporative b) Adjust the air flow for proper temperature difference c) Describe maintenance of a condenser and a cooling tower d) Demonstrate good customer relations in a classroom simulation e) Determine equipment electrical requirements f) Verify equipment air flow and distribution requirements g) Check operation of all electrical components including control components h) Demonstrate the use of tools and test equipment i) Read and demonstrate understanding of electrical wiring diagrams 	

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| | <ul style="list-style-type: none"> j) Develop a systematic way to diagnose system problems and demonstrate in class k) Determine the cause of failure in a system l) Identify and describe possible causes of failure and how to eliminate m) Verify system operation n) Write a service report o) Identify types of control systems: electromechanical, pneumatic, electronic, and programmable p) Identify control system components q) Describe the sequences of operation in all types of control systems r) Construct a schematic diagram using all components necessary to safely operate an air conditioner s) Program a programmable thermostat for heating, cooling, and heat pump operation including set up and set back t) Plot and chart psychrometric terms. | |
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Connections:

- *Common Core State Standards
- *Kentucky Occupational Skills Standards Assessment
- *Common Core Technical Standards
- *New Generation Science Standards
- *Post-Secondary KCTCS ACR280
- *CTSO's—Skills USA

Co-op (Air Cond)

460880

Course Description

Co-op I provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the Cooperative Education program receive compensation for their work.

Prerequisites: Consent of Instructor

Content/Process

1

Co-op (Air Cond)

- a) Gain career awareness and the opportunity to test career choice(s)
- b) Receive work experience related to career interests prior to graduation
- c) Integrate classroom studies with work experience
- d) Receive exposure to facilities and equipment unavailable in a classroom setting
- e) Increase employability potential after graduation
- f) Earn funds to help finance educational expenses

Connections

- *Secretary's Commission on Achieving Necessary Skills (SCANS)
- *National Center for Construction Education Research (NCCER)
- *21st Century Skills
- *Common Core State Standards ELA and Math
- *Interdisciplinary Course

Electrical Components

460826

Course Description

This course defines the electrical components of an air conditioning system. Different types of line voltages, wiring diagrams, and solid-state devices are included. Safety is emphasized.

TASK LIST

1

Electrical Components:

- a) Practice/observe safety procedures/techniques
- b) Measure voltage with digital and analog voltmeters
- c) Measure AC current with a clamp-on ammeter
- d) Check winding insulation with a megohmmeter
- e) Define watts, ohms, volts, amps
- f) Define and compare single and multi-phase voltage and current
- g) Demonstrate proper use of ohmmeter, ammeter, and voltmeter. (Voltage, Ohms, Capacitance, & Micro Amps
- h) Calculate electrical circuit loads
- i) Use appropriate meters to check fuses and breakers
- j) Interpret tables and charts from National Electrical Code (NEC)
- k) Figure wire sizes and voltage drop
- l) Draw and identify power transformer types
- m) Size and test fuses and breakers and safely replace them
- n) Use NEC tables to size Conduit
- o) Define relays, sequencers, contactors, capacitors, defrost timers, crankcase heaters, water valves, damper actuators, thermostats, controllers, rheostats, zone valves, solenoids
- p) Explain the operation and application of: split phase motors, three phase motors, variable speed motors, shaded pole motors, and permanent split capacitor motors
- q) Demonstrate proper use of testing equipment for motors
- r) Interpret detailed instructions for wiring circuits
- s) Draw electrical circuits in accordance with standard wiring procedures
- t) Wire actual electrical circuits from wiring diagrams
- u) Explain the use of various electrical components in HVACR
- v) Interpret schematic wiring diagrams into a sequence of operation for HVACR equipment
- w) Rewire a HVACR unit using a schematic diagram
- x) Develop an approved routine for electrical troubleshooting

Connections:

Common Core State Standards

KOSSA

Common Core Technical Standards

New Generation Science Standards

Course Description

This course will instruct students in the areas of energy management and analysis, green heating, ventilation, air conditioning and refrigeration. It will also cover electrical generation and consumption as well as green plumbing.

Content/Process

	<p>Safety:</p> <ul style="list-style-type: none"> a) Review safety rules and student responsibilities 	
<p>1</p>	<p>Energy Consumption:</p> <ul style="list-style-type: none"> a) Discuss core renewable energy and sustainable energy b) Discuss commercial building energy consumption surveys c) Explain different energy conservation measures d) Discuss the importance of energy audits e) Explain energy consumption and demand analysis f) Introduce heat load calculations g) Discuss lighting florescence versus LED h) Explain ghost loads i) Review and discuss residential appliance energy usage j) Introduce potable water conservation flow restriction faucets, showerheads, pre-rinse waterless urinals k) Discuss high efficiency plumbing appliances: clothes washers, dishwashers, ice machines, garbage disposals l) Explain first hour rating system m) Explain drain water heat recovery systems n) All students will take the Green Mechanical Certification Exam 	
<p>2</p>	<p>HVAC Systems and Equipment:</p> <ul style="list-style-type: none"> a) Explain life equipment life cycle and cost analysis b) Cover HVAC energy efficiency Ratio c) Discuss HVAC seasonal energy efficiency ratio SEER d) Discuss HVAC heating season performance factors e) Explain HVAC coefficient of performance f) Discuss and test HVAC ventilation and indoor air quality g) Review mechanical HVAC equipment h) Discuss evaporative cooling and passive cooling systems i) Explain solar cooling and thermal storage systems 	

	<ul style="list-style-type: none"> j) Review heating combustion analysis k) Review forced air heating systems l) Review condensing furnaces and modulating furnaces m) Explain condensing boilers and instantaneous boilers n) Review geothermal systems and air to air heat pumps o) Review package terminal air conditioning p) Review mini-split AC systems q) Explain industrial fire protection systems and residential fire protection systems 	
3	<p>Refrigeration Equipment:</p> <ul style="list-style-type: none"> a) Introduce commercial refrigeration and U.S EPA Green Chill Advanced Refrigeration Partnership b) Discuss refrigeration replacement equipment 	
4	<p>Hot Water Systems and Equipment:</p> <ul style="list-style-type: none"> a) Explain solar hot water and comfort heating systems b) Discuss waste water heat recovery c) Discuss radiant panel systems and thermal mass d) Explain optimized steam systems and steam traps e) Introduce hot water distribution systems f) Introduce hot water circulating systems g) Explain different types of water heating systems storage tank, tankless, heat pump water heaters, indirect, and solar h) Explain rain water harvesting i) Explain Green plumbing systems relevance to LEED 	
5	<p>Power Sources:</p> <ul style="list-style-type: none"> a) Define and discuss electrical power and nuclear power b) Explain fuel cells c) Introduce photovoltaic and wind turbines as power sources d) Explain tidal and ocean energy applications 	
<p>Connections:</p> <ul style="list-style-type: none"> *Common Core State Standards *Kentucky Occupational Skills Standards Assessment *Common Core Technical Standards *New Generation Science Standards *Post-Secondary KCTCS ACR290 *CTSO's—Skills USA 		

Heat Load/Duct Design

480812

Course Description

Introduces the fundamentals needed to calculate heat gain and heat loss, thereby determining air conditioner/furnace size. This information will be used to calculate the correct duct size. Procedures to lay out a duct system as outlined in ACCA MANUAL D are presented.

Content/Process

1	<p>Terminology:</p> <ul style="list-style-type: none"> a) Define "U" value b) Define "R" value c) Interpret heat transfer tables ("U", "R") d) Calculate total heat transfer valve of any surface (R) - (U) e) Explain: specific humidity, apparatus dew point, contact factor, relative humidity, dry-bulb, wet-bulb, dew point, and enthalpy 	
2	<p>Manual "J" Heat Loss Gain:</p> <ul style="list-style-type: none"> a) Explain the heat load sources: conduction, infiltration, product, miscellaneous loads (people, motors, equipment) b) Explain the purpose of vapor barriers c) Interpret tables of specific heat values, latent heat, and heat of respiration d) Calculate: refrigeration-sensible heat ratio, contact factor, latent heat, sensible heat, total heat, water removal, mixed air condition e) Determine total resistance to heat flow ("R"), ("U") f) Interpret structure design data g) Interpret building prints - size of rooms, etc. h) Calculate conduction loss for: walls, roof, floors, windows, basement (walls, floor), unconditioned space i) Calculate infiltration: doors, windows j) Calculate ventilation load k) Calculate ventilation load l) Calculate duct loss m) Calculate "U" values for building materials n) Calculate CLTD (Cooling Load Temperature Difference) o) Make corrections for CLTD p) Calculate conduction loads for: walls, roofs, windows, doors, non-conditioned space, floors q) Calculate lighting load r) Determine size of equipment needed s) Calculate infiltration and ventilation t) Calculate duct gain 	

3	Manual “D” Duct Design: <ul style="list-style-type: none"> a) Draw layout of return and supply runs b) Calculate equivalent length of trunk and branch ducts c) Calculate total effective length of duct runs d) Calculate total available static pressure e) Size trunk and branch ducts by equal friction method f) Use duct calculator to find duct size, velocity, CFM, and friction loss g) Calculate air flow factors for heating and cooling h) Size registers, grills, and diffusers 	
4	Air Filtration: <ul style="list-style-type: none"> a) Identify types of mechanical filters: disposable, permanent foam, mesh, fiber, and high efficiency b) Describe operation of electronic air cleaners 	
Connections: *Secretary’s Commission on Achieving Necessary Skills (SCANS) *National Center for Construction Education Research (NCCER) *21 st Century Skills *Common Core State Standards ELA and Math *Interdisciplinary Course		

Heat Pump Application

460801

Course Description

Explains reverse cycle heating systems, defrost cycles, reversing valves, and auxiliary heating. This course will also concentrate on the line and control voltage circuitry pertaining to these units. ARI Controls: Subtopic E; Heat Pump Systems: Subtopics A and B; System Installation and Start-Up: Subtopic C; System Servicing and Troubleshooting: Subtopic E

Content/Process

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| 1 | <p>Heat Pump Application:</p> <ul style="list-style-type: none">a) Practice/observe safety procedures/techniquesb) Explain the basic theory of heat pump operationc) Compare heat pump systems based on performance rating information: COP, SEER, balance points, economicsd) Analyze and explain the refrigerant cycle in both heating and cooling modese) Identify and describe different types of heat pump systems: air to air, water to air, water to water, air to water, air to ground, open loop, and closed loopf) Analyze and compare the operation and performance of the different types of heat pump systemsg) Explain the operation and function of a reversing valveh) Identify the main types of defrost controlsi) Explain the operation of each type of defrost controlj) Describe the purpose and function of outdoor thermostatsk) Describe the sequence and purpose of emergency heat controlsl) Describe the purpose and function of Metering devicesm) Install or replace a heat-sequencing relayn) Identify and explain the operation and function of the electrical and mechanical components of the heat pumpo) Explain the importance of manufacturers' installation and operation requirementsp) Determine equipment electrical requirementsq) Verify equipment air flow and distributionr) Check operation of all electrical components including control componentss) Check system operation in the heating and cooling modes while following safety procedurest) Follow local codes and ordinances during installation and repairu) Read and demonstrate an understanding of electrical wiring diagramsv) Develop systematic way to diagnose system problems and demonstrate method in classw) Identify and describe all possible causes of failure and how to | |
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	eliminate causes x) Use appropriate tools and test equipment while following safety practices y) Verify system operation	
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Connections:

*Secretary's Commission on Achieving Necessary Skills (SCANS)

*National Center for Construction Education Research (NCCER)

*21st Century Skills

*Common Core State Standards ELA and Math

*Interdisciplinary Course

Heating and Humidification

460820

Course Description		
Explains heating systems from simple fossil fuel furnaces through more complex systems. This course will also concentrate on the line and control voltage circuitry pertaining to these systems. ARI Controls: Subtopics A-C; Heating Systems: Subtopics A-C; System Installation and Start-Up: Subtopics A and B; System Servicing and Troubleshooting: Subtopic C; Tools and Equipment: Subtopic D		
Content/Process		
1	<p>Safety:</p> <ul style="list-style-type: none"> a) Practice/observe safety procedures/techniques b) Perform safety lockout procedures for burners c) Test a fan/limit control to identify a set point of control d) Test all safety controls e) Check ignition systems while following all safety principles f) Use tools and test equipment appropriately while following safety practice 	
2	<p>Valves:</p> <ul style="list-style-type: none"> a) Check coil resistance of a valve coil b) Test gas valve operation c) Check the voltage at gas valve operator d) Check pressure at inlet vs. outlet of gas valve e) Explain the operation of a solenoid valve f) Identify limited, non-adjustable and adjustable regulators g) Determine application of gas valves h) Check water-regulating valve operator i) Discuss TXV valves and their operation 	
3	<p>Pilot Devices:</p> <ul style="list-style-type: none"> a) Differentiate between pilot proving devices b) Explain the operation of flame rod, mercury flame switch, bimetal, and millivolt flame sensors c) Test and change a thermocouple flame sensor d) Clean the pilot assembly 	
4	<p>Thermostats:</p> <ul style="list-style-type: none"> a) Identify and install residential heating and cooling thermostats b) Check and adjust the heat anticipator c) Set aquastat 	

	<ul style="list-style-type: none"> d) Identify and define the difference between Communications and Non Communications Thermostats. e) Set a Programmable Thermostat 	
5	<p>Furnace Gas Systems:</p> <ul style="list-style-type: none"> a) Perform a regular conversion on a gas valve from natural gas to LP or reverse: low, line voltage, redundant, two-stage, and modulating b) Test and adjust the fuel system of furnace c) Measure gas pressure with a manometer d) Adjust burner system to recommended efficiency e) Perform pressure checks on the venting system f) Adjust the regulator g) Determine air velocity within a duct via: Pitot tube/magnehelic h) Determine air velocity at grills and diffusers via: vane style anemometer, hot wire anemometer, pilot tube, and digital anemometer i) Measure temperature difference across heating and cooling equipment j) Verify equipment air flow and distribution requirements k) Check operation of gas train components and measurements l) Check for correct heating input and adjust to manufacturers' specifications m) Demonstrate an understanding of combustion theory n) Determine combustion air requirements o) Verify system operation 	
6	<p>Heating</p> <ul style="list-style-type: none"> a) Test spark ignition modules b) Wire a complete heating system - line and low voltage c) Identify controls for heating and cooling d) Check the ignition system e) De-rate or change over a gas burner f) Check for proper temperature rise across the furnace g) Set proper air distribution in house h) Remove, install, and adjust blower motor and/or belt i) Adjust individual register outlets to properly balance system j) Demonstrate good customer relations in a classroom simulation k) Explain the importance of manufacturers' installation and operation requirements l) Determine equipment electrical requirements m) Check operation of all electrical control components n) Demonstrate use of tools and instruments o) Test for proper combustion p) Check electrical components for operation and wiring connections q) Read electrical wiring diagrams and demonstrate an understanding of wiring diagrams r) Develop a systematic way to diagnose system problems and demonstrate in class 	

	<ul style="list-style-type: none"> s) Determine cause of failure in a heating system t) Identify and describe all possible causes of failure and how to eliminate causes u) Write a service report v) Demonstrate good Customer relations 	
7	<p>Cooling & Heat pump (Super-heat & Sub-Cooling)</p> <ul style="list-style-type: none"> a) Determine what type of Freon is in the system b) Hook up refrigeration manifold to system c) Start system and allow to settle reading on gauges d) Install line temperature measurement probes e) Read gauge pressure and saturation temperature f) Read line temperature from thermometer on high and low side g) Determine superheat (suction) and sub cooling (liquid) h) Demonstrate proper shut down i) Remove testing equipment properly j) Restart equipment and put in normal operation 	
8	<p>Humidification</p> <ul style="list-style-type: none"> a) Wire a humidistat into electrical circuit b) Determine the relative humidity (using a sling psychrometer) 	
9	<p>Fuel Oil:</p> <ul style="list-style-type: none"> a) Measure resistance of a cad cell during operation b) Check safety control for proper timed operation on shut down c) Check oil burner components and measurements d) Evaluate fuel supply systems e) Change Fuel oil filter f) Clean oil pump strainer g) Measure chimney draft with a draft gauge h) Determine the efficiency of an oil pump using a vacuum gauge and a pressure gauge i) Check for proper oil pressure at fuel pump j) Remove drawer assembly and change nozzle and adjust ignitors k) Change oil pump coupler l) Install delay fuel oil valve m) Perform an efficiency test on an oil-gas burner: smoke test, CO2 test, and O2 test n) Set Over the fire draft o) Set breech draft 	
10	<p>Boilers:</p> <ul style="list-style-type: none"> a) Oil motor(s) and bearings b) Check circulator for alignment and lubrication c) Check system for any gasket leaks @ tankless and circulators d) Remove air from water system e) Inspect/change zone valve operator f) Wire a multizone / multipump hydronic system 	

	<ul style="list-style-type: none"> g) Identify types of hydronic piping systems h) Observe proper draft conditions i) Test boiler efficiency and clean if necessary j) Set aqua stat 	
11	<p>Codes</p> <ul style="list-style-type: none"> a) Describe the reasons for codes b) Discuss three model codes: Boca, standard, uniform c) Identify the codes and standards for the applicable area, locality, or state d) Discuss the relationship between codes and manufacturers' installation instructions e) Identify standards not covered by codes: ARI, ASHRAE, SMACNA 	
<p>Connections:</p> <ul style="list-style-type: none"> *Common Core State Standards *Kentucky Occupational Skills Standards Assessment *Common Core Technical Standards *Post-Secondary KCTCS MTH100 *CTSO's—Skills USA 		

HVAC Electricity

460817

Course Description

This course introduces students to the basic physics of electricity. Students apply Ohm's law; measure resistance, voltage, ohms, watts and amps; construct various types of electrical circuits; select wire and fuse sizes; and learn to troubleshoot an electric motor and motor controls.

Content/Process

1

HVAC Electricity:

- a) Demonstrate electrical safety
- b) Measure ohms with an ohmmeter
- c) Measure voltage with a voltmeter
- d) Measure amps with an ammeter
- e) Measure watts with a wattmeter
- f) Solve electrical circuit problems using Ohm's Law
- g) Draw and interpret electrical symbols
- h) Construct series circuits
- i) Construct parallel circuits
- j) Construct parallel circuits
- k) Connect, operate, and identify the types of single-phase motors
- l) Measure the resistance of windings in a split-phase motor and identify the start/run windings
- m) Test capacitors
- n) Select wire and fuse sizes
- o) Test transformers
- p) Locate faults in electrical circuits
- q) Identify types of 3-phase power supplies
- r) Troubleshoot magnetic motor starters and coils

Connections:

- *Secretary's Commission on Achieving Necessary Skills (SCANS)
- *National Center for Construction Education Research (NCCER)
- *21st Century Skills
- *Common Core State Standards ELA and Math
- *Interdisciplinary Course

Ice Machines

460845

Course Description

Introduces the operation, checking, adjusting, and troubleshooting of commercial ice makers. The student will learn to adjust, check, clean, and troubleshoot commercial ice machines.

Prerequisites: ACR 100 and ACR 102

Content/Process

1

Ice Machines:

- a) Practice/observe safety procedures/techniques
- b) Explain the operation of ice making
- c) Follow manufacturers' instructions for cleaning the evaporator
- d) Clean the condenser
- e) Check the harvest cycle
- f) Adjust cube size
- g) Check for and repair leaks
- h) Inspect the electrical circuit
- i) Adjust the metering device for proper operation
- j) Measure grid heater current when applicable
- k) Clean ice storage bin
- l) Inspect and clean drains as necessary
- m) Replace bearings in flake-type machine
- n) Check and adjust the water level
- o) Check and adjust water pressure
- p) Level machine
- q) Check water pump
- r) Explain water spray system for ice making
- s) Treat water properly

Connections:

*Secretary's Commission on Achieving Necessary Skills (SCANS)

*National Center for Construction Education Research (NCCER)

*21st Century Skills

*Common Core State Standards ELA and Math

*Interdisciplinary Course

Industrial Safety

499930

Course Description

This course provides practical training in industrial safety. The students are taught to observe general safety rules and regulations, to apply work site and shop safety rules, and to apply OSHA regulations. Students are expected to obtain certification in first aid and cardiopulmonary resuscitation.

Content/Process

1

Industrial Safety:

- a) Apply work site and lab safety procedures
- b) Apply personal safety rules and procedures
- c) Apply fire prevention rules and procedures
- d) Obtain first aid certification
- e) Obtain CPR certification (Recommended but not required)
- f) Demonstrate hazardous communications procedures
- g) Describe and demonstrate universal precautions procedures
- h) Obtain OSHA 10 certification (recommended but not required)

Connections:

- *Secretary's Commission on Achieving Necessary Skills (SCANS)
- *National Center for Construction Education Research (NCCER)
- *21st Century Skills
- *Common Core State Standards ELA and Math

Internship (Air Cond)

460883

Course Description

Internship provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the internship do not receive compensation..

Content/Process

1

Internship (Air Cond):

- a) Gain career awareness and the opportunity to test career choice(s)
- a) Receive work experience related to career interests prior to graduation
- b) Integrate classroom studies with work experience
- c) Receive exposure to facilities and equipment unavailable in a classroom setting
- d) Increase employability potential after graduation

Connections:

- *Kentucky Occupational Skills Standards Assessment
- *National Center for Construction Education Research (NCCER)
- *Common Core Standards
- *21st Century Skills

Journeyman Preparation

460846

Course Description

A series of lectures, discussions, and presentations pertaining to the proper application of HVAC codes. The class will help prepare the student to pass the Kentucky Journeyman HVAC licensing exam.

Content/Process

1

Journeyman Preparation:

- a) Explain the importance of local licensing codes
- b) Explain how the codes affect the installation and operation of HVAC equipment
- c) Explain the relationship between manufacturers' suggested installation procedures and codes
- d) Explain the importance of codes as they pertain to safety
- e) Compare commercial codes and codes that pertain to residential applications
- f) Demonstrate knowledge of codes that relate to the installation of HVAC equipment

Connections:

- *Common Core State Standards
- *Kentucky Occupational Skills Standards Assessment
- *Common Core Technical Standards
- *New Generation Science Standards
- *Post-Secondary KCTCS ACR290
- *CTSO's—Skills USA

Refrigeration Fundamentals

460828

Course Description

Introduces the fundamentals of refrigeration, refrigeration terms, and the basic refrigeration cycle. Proper use of tools, test equipment, and materials is stressed. Environmental issues including refrigerant handling are discussed. Refrigerant piping and methods used to join them are taught. General and specific safety is emphasized.

Content/Process

1	<p>The Basic Refrigeration System:</p> <ul style="list-style-type: none"> a) Explain the history of refrigeration b) Identify and explain the operation of the four major components c) Identify the high and low sides of the system d) Explain the four parts of the refrigeration cycle e) Draw a mechanical refrigeration system diagram f) Explain the benefits of superheat and subcooling g) Describe heat exchange techniques h) Explain saturation temperature i) Identify different types of evaporators j) Identify different types of compressors k) Identify different types of metering devices l) Identify different types of condensers m) Identify refrigeration system accessories 	
2	<p>Thermal Dynamics, Heat and Pressure:</p> <ul style="list-style-type: none"> a) Define matter and heat b) Distinguish between the three states of matter c) Explain the direction and rate of heat flow d) Describe the three methods of heat transfer e) Identify the reference points of temperature: boiling point, freezing point, critical temperature, absolute zero f) Explain the difference between heat and temperature g) Explain the difference between latent and sensible heat h) Explain the relationship of pressures and fluids at different temperatures i) Calculate absolute and gauge pressures j) Compare temperature with pressure (T/P chart) k) Explain why fluids flow 	
3	<p>Refrigerants:</p> <ul style="list-style-type: none"> a) Define the properties of refrigerants b) Explain the uses of different refrigerants c) Identify color coding of refrigerant cylinders d) Explain classifications of refrigerants 	

	<ul style="list-style-type: none"> e) List proper transfer and storage of refrigerants f) Identify the effects of improper refrigerant in a system g) Attain EPA-608 Certification 	
4	<p>Equipment Installation and Materials:</p> <ul style="list-style-type: none"> a) Identify fasteners: bolts, screws, masonry anchors, various electrical connectors, conduit, pipe and cable clamps, nails, etc... b) Identify types of pipe and tubing used in refrigeration work c) Identify various types of fittings d) Describe methods of insulating pipe and tubing e) Identify soldering and brazing alloys used in HVACR f) Explain applications of soldering and brazing alloys g) Flare copper tubing h) Swage copper tubing i) Bend copper tubing j) Identify types of torches 	
5	<p>Tools and Instrumentation:</p> <ul style="list-style-type: none"> a) Measure absolute and gauge pressures b) Identify basic tools and accessories: various screwdrivers, nutdrivers, socket wrenches, Allen wrenches, open end and box end wrenches, flare wrenches, etc.. c) Identify power tools: various drills, reciprocating saw, circular saw, portable band saw, jig saw, etc... d) Identify pipe and tubing tools: pipe cutters, tubing cutters, reamers, threaders, benders, flaring tools, swaging tools, pipe vises, etc... e) Describe lubrication methods utilizing grease guns, oilers and sprays f) Measure pressures with a refrigeration gauge manifold g) Evacuate a system with a two stage vacuum pump h) Measure vacuums with an electronic vacuum gauge i) Measure temperatures with various thermometers j) Solder and braze copper piping / tubing k) Cut, ream and thread black iron pipe 	
6	<p>System Operation, Service and Maintenance:</p> <ul style="list-style-type: none"> a) Practice / observe safety practices & techniques b) Charge a system with refrigerant using an electronic charging scale c) Charge a system with refrigerant on the liquid side as well as the suction side d) Check for refrigerant leaks using various methods e) Repair refrigerant leaks f) Test and adjust all operating and safety controls g) Replace liquid line filter driers h) Inspect electrical circuit for defective connections and make repairs if needed i) Interpret electrical wiring diagrams j) Clean out condensate drain lines k) Check voltage supply and amp draw of all electrical components 	

	l) Clean a condenser coil (air & water) m) Clean an evaporator coil n) Perform all aspects of preventive HVACR maintenance	
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Connections:

*Secretary's Commission on Achieving Necessary Skills (SCANS)

*National Center for Construction Education Research (NCCER)

*21st Century Skills

*Common Core State Standards ELA and Math

*Interdisciplinary Course

Residential Energy Auditor Prep

460804

Course Description

This course will provide step by step instruction and best practices involved in performing a residential energy audit. Ethics and customer relations, energy consumption and quality control inspecting. Building shell diagnosing, shell leakage, evaluating heating systems. Evaluation base load measures, windows, doors, and exterior insulation evaluations. Mobile homes and health and safety issues are also covered.

Permission of the Instructor

Content/Process

1	<p>Safety & Health:</p> <ul style="list-style-type: none"> a) Students will receive safety training applied to energy auditing b) Discuss safety considerations for air leakage c) Discuss combustion safety d) Evaluate chimneys and liners and safety e) Discuss and evaluate health and safety issues pollutant sources and Co f) Inform students about lead - safe weatherization g) Practice electrical safety 	
2	<p>Energy Auditor Prep:</p> <ul style="list-style-type: none"> a) Discuss the purpose of an energy audit b) Explore the energy auditing process, visual inspection/ diagnostics testing/ numerical analysis c) Examine differences of work inspections/ in progress inspections/ final inspections/quality assurance/energy auditing gas and ethics d) Students will practice evaluating attic and roof insulation/ story and a half homes and closed roof cavities e) Students will practice evaluating walk-up stair ways and doors/ retractable attic stairways f) Students will perform evaluation of wall insulation 	
3	<p>Ethics and Consumer Relations:</p> <ul style="list-style-type: none"> a) Students will practice customer relations/ communication skill/customer interview/ best sales practices b) Students will practice customer education/ reducing heating consumption/ hot water and laundry/ cooling consumption c) Students will receive instruction on using Infrared and thermal scanning 	
4	<p>Building Shell Diagnosing and Shell Leakage:</p> <ul style="list-style-type: none"> a) Discuss safety considerations for air leakage b) Students will observe and learn about air leakage problems and 	

	<p>solutions</p> <ul style="list-style-type: none"> c) Discuss goals of air leak testing/ use of blower door d) Discuss and practice air sealing approaches e) Discuss crawl space moisture control f) Describe heat sink methods g) Evaluate moisture problems and mold h) Perform evaluation of shell leakage 	
5	<p>Evaluate Heating & Air Condition Systems:</p> <ul style="list-style-type: none"> a) Evaluate heating system replacement b) Perform inspection of gas and oil furnaces c) Discuss wood stoves safety and venting d) Test draft and venting of combustion air e) Practice leak testing gas piping f) Perform co carbon monoxide testing pap g) Discuss ways of improving inadequate draft h) Evaluate duct air distribution i) Practice evaluating duct leakage j) Discuss duct insulation and type k) Discuss instructions and installation of programmable thermostats l) Perform electric heating inspections m) Perform heat pump inspections n) Practice evaluating central air conditioning system o) Check duct leakage and air flow p) Review ASHRAE 6.2.2-2007 ventilation standards q) Evaluate whole house ventilation systems 	
6	<p>Evaluate Water Heaters:</p> <ul style="list-style-type: none"> a) Complete water heater inspection gas/ electric/ tankless/solar b) Evaluate water heater energy savings 	
7	<p>Evaluation Base Load measures, Windows, doors, and Exterior Insulation:</p> <ul style="list-style-type: none"> a) Students will be instructed on understanding energy usage/ base load usage/seasonal usage/ energy index/electrical peak load/carbon foot print b) Student will identify thermal bounding decisions/ determining floor and foundation insulation c) Discuss combustion safety d) Evaluate chimneys and liners and safety e) Practice air conditioning equipment sizing f) Discuss lighting improvements g) Explore different window shading/ treatments interior and exterior h) Observe and discuss landscaping for shade i) Discuss exterior storm windows j) Evaluate window replacement and weather striping k) Evaluate window replacement and weather striping l) Evaluate moisture problems and mold m) Practice evaluating belly and side wall insulation 	

	n) Discuss evaluation of windows and doors/replacement	
8	Mobile Homes: a) Evaluate moisture problems and mold b) Discuss crawl space moisture control c) Explore mobile home general auditing task d) Practice evaluating mobile home insulation e) Practice evaluating belly and side wall insulation f) Perform evaluation of shell leakage g) Discuss evaluation of windows and doors/replacement	
Connections: *Common Core State Standards *Kentucky Occupational Skills Standards Assessment *Common Core Technical Standards *New Generation Science Standards *Post-Secondary KCTCS ACR280 *CTSO's—Skills USA		

Sheet Metal Fabrication

460847

Course Description

The student will learn to make patterns and lay out and construct common sheet metal duct fittings.

Content/Process

1

Sheet Metal Fabrication:

- a) Lay out and construct common sheet metal duct fittings
- b) Construct duct connectors of all shapes and sizes
- c) Construct duct couplings of all shapes and sizes
- d) Construct three-way and four-way duct fittings of various sizes
- e) Lay out a duct system for a residence or commercial building
- f) Install duct system in a residence or commercial building

Connections:

- *Common Core State Standards
- *Kentucky Occupational Skills Standards Assessment
- *Common Core Technical Standards
- *New Generation Science Standards
- *Post-Secondary KCTCS ACR112
- *CTSO's—Skills USA

Special Problems (Air-Conditioning)

460877

Course Description		
This course is designed for the student who has demonstrated specific special needs.		
Content/Process		
1	Selected tasks/problems as determined by the instructor	
Connections: *Common Core State Standards *KOSSA *Common Core Technical Standards *New Generation Science Standards CTSO's – Skills USA		