LAUSD UNIFIED Division of Adult and Career Education

Career Technical Education (CTE) Course Outline

Course Title:	Auto Tech: Heating & Air Conditioning
Course Number:	79-90-76
Date:	July 2024
Industry Sector:	Transportation
Pathway:	Systems Diagnostics and Service
CBEDS Title:	Advanced Automotive
CBEDS Code:	5669
Credits:	10

Hours:

Total
150

Course Description:

This competency-based course provides students with technical instruction and practical experience in an automobile area incorporating sustainable and green vehicle technologies. Instruction includes an introduction, safety-general, resource management, trade mathematics, tools and equipment, service manuals and computer-based information systems, a/c system diagnosis and repair, refrigeration system diagnosis and repair, heating, ventilation, and engine cooling systems diagnosis and repair, operating systems and related controls diagnosis and repair, refrigerant recovery, recycling, and handling, employability skills and resume preparation, and entrepreneurial skills. The competencies in this course are aligned with the California High School Academic Content Standards and the California Career Technical Education Model Curriculum Standards.

Prerequisites:	Enrollment requires successful completion of Technology/1: Automotive Systems (79-90-83) and Technology/2: Automotive Systems (79-90-85) courses.
NOTE:	For Perkins purposes this course has been designated as a **capstone** course. This course **cannot** be repeated once a student receives a Certificate of Completion.
A-G Approval	N/A
Methods of Instruction:	Lecture and discussion, multimedia presentations, visual aids, projects, individualized instruction, shop work
Student Evaluation:	Summative: End of section assessments
Industry Certification:	N/A
Recommended Texts:	Duffy, James E. Modern Automotive Technology, 10th Edition. Goodheart-Willcox Publishing, 2022. Johanson, Chris. Auto Heating & Air Conditioning, 5th Edition. Goodheart-Willcox Co., 2021.
Link to Resource Folder	https://bit.ly/autotechheatingairresources

Approved by: Renny L. Neyra, Executive Director

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
A. INTRODUCTION Understand, apply, and evaluate classroom and workplace policies and procedures. (2 hours)	1. Discuss the scope and purpose of the course. 2. Discuss the classroom policies and procedures. 3. Discuss and demonstrate Zoom, Schoology, and basic computer skills. 4. Assess students' basic knowledge in heating and air conditioning principles. 5. Discuss, identify, research, and draw conclusions on the different career paths, occupations, employment outlook, and career advancements in the transportation industry sector which have an impact on vehicles. 6. Discuss the opportunities available for promoting gender equity and the representation of non-traditional populations in the automotive industry. 7. Explain and recognize the importance of ethics, teamwork, respecting individual and cultural differences and diversity in the workplace. 8. Describe the role of the Automotive Service of Excellence (ASE) as it applies to the automotive industry. 9. Describe the role of the Automotive Service Education Foundation (ASEF) in auto technician training.	**Career Ready Practice:** 1, 2, 3, 4, 5, 8, 9, 10, 11 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Career Planning & Management: 3.1, 3.4, 3.5, 3.6, 3.9 Technology: 4.1, 4.5 Problem Solving & Critical Thinking: 5.4 Ethics & Legal Responsibilities: 8.2, 8.3, 8.4, 8.5 Leadership & Teamwork: 9.3, 9.4, 9.6 Demonstration & Application: 11.1, 11.2 **CTE Pathway:** C2.6
B. SAFETY - GENERAL Understand safety procedures and techniques in the auto repair and maintenance sector.	1. Discuss classroom and workplace first aid, emergency procedures, and accidents or injury prevention. 2. Discuss the California Occupational Safety and Health Administration (Cal/OSHA) workplace requirements for auto technicians to maintain a safe and healthy working environment. 3. Discuss the impact of Environmental Protection Agency (EPA) legislation on Transportation Industry Sector practices in protecting and preserving the environment.	**Career Ready Practice:** 1, 2, 10, 12 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3

(3 hours)	4. Describe and demonstrate ASEF standards regarding proper handling, storage and disposal of chemicals and materials used in an auto shop. 5. Discuss the impact of California Air Resources Board (ARB) legislation on the Transportation Industry Sector. 6. Discuss the Bureau of Automotive Repair (BAR) standards for consumer and environmental protection. 7. Discuss the use of the Safety Data Sheet (SDS) as it applies to the automotive industry. 8. Discuss the safety items required by the federal, state, and local regulations. 9. Discuss the importance of proper personal hygiene in the classroom and auto shop. 10. Describe and demonstrate the standards regarding proper use of protective equipment in an auto shop: a. clothing and gloves b. respiratory gear c. eye gear d. work shoes e. ventilation f. handling, storage, and disposal of chemicals and hazardous materials used in an auto shop g. proper use of tools and equipment 11. Practice personal safety when lifting, bending, or moving equipment and supplies. 12. Pass the safety test with 100% accuracy.	Health & Safety: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7 Technical Knowledge & Skills: 10.2, 10.4 Demonstration & Application: 11.1 **CTE Pathway:** C1.2, C1.4, C2.2
C. RESOURCE MANAGEMENT Understand, apply, and evaluate the resource management principles and techniques in the auto repair and maintenance field.	1. Define and describe the benefits of the following: a. resources b. management c. sustainability d. profitability e. company growth 2. Describe and list specific examples of the effective management of the following resources in the auto shop repair and maintenance business: a. time b. materials c. personnel 3. Pass a resource management assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 7 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3 Responsibility & Flexibility: 7.1, 7.4 Technical Knowledge & Skills: 10.1

(1 hour)		**CTE Pathway:** C5.2
D. TRADE MATHEMATICS Understand, apply, and evaluate the mathematical requirements used in auto diagnosis, maintenance, and the repair field. (2 hours)	1. Define and identify the practical math terminology in auto repair and maintenance. 2. Describe, demonstrate, and ask questions regarding problem-solving techniques involving: a. basic trade mathematical operations. b. changing fractions to decimals c. changing decimals to fractions d. engineering notation 3. Describe, demonstrate, and interpret the English and metric units of the measuring system and draw conclusions to make informed decisions. 4. Describe and demonstrate problem-solving techniques for: a. algebraic problems b. percentages c. reading and interpreting graphs d. calculator e. geometric problems that apply to auto repair and maintenance such as angles and degrees 5. Pass a trade mathematics assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 5, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3 Problem Solving & Critical Thinking: 5,1, 5.2 Technical Knowledge & Skills: 10.1 Demonstration & Application: 11.1 **CTE Pathway:** C2.4
E. TOOLS AND EQUIPMENT Understand, apply, and evaluate the policies and procedures for using drive train tools and equipment.	1. Define, discuss, and demonstrate the proper use, maintenance, and storage techniques for the following specialty tools and equipment for heating and air conditioning: a. A/C compressor clutch service tools b. A/C service port Adapter set c. dye and oil injector d. hygrometer e. leak detector (SAE Standard) f. manifold gauge set or equivalent (HFC-134a, R1234YF) g. refrigerant charging station (HFC-134a, R1234YF) or equivalent h. refrigerant identification equipment i. refrigerant recovery/recycling machine (HFC-134a, R1234YF) j. thermometer 2. Explain and demonstrate the following: a. selection of the appropriate hand, power tools, and equipment for each job	**Career Ready Practice:** 1, 2, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3 Health & Safety: 6.4 Technical Knowledge & Skills: 10.1 Demonstration & Application: 11.1 **CTE Pathway:**

(6 hours)	b. procedure for checking out hand, power tools, and equipment from the tool room c. safe use of the most common hand, power tools and equipment d. practice personal safety when lifting, bending, or moving equipment and supplies 3. Pass a tools and equipment assessment with an 80% score or higher.	C2.2, C2.3
F. SERVICE MANUALS AND COMPUTER-BASED INFORMATION SYSTEMS Understand, apply, and evaluate the contents of service manuals and computer-based information systems as important sources of reference to an auto technician. (2 hours)	1. Identify the different types of service manuals. 2. State the different types of information that can be found in service manuals such as specifications, troubleshooting charts, and repair information. 3. Describe and demonstrate the use of service manuals. 4. Describe and demonstrate the use of web-based search engines in finding automotive technical information. 5. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. 6. Pass a service manual and computer-based information system assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 4, 10, 11 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3 Technology: 4.1, 4.2 Demonstration & Application: 11.1 **CTE Pathway:** C2.6, C4.3, C4.4
G. A/C SYSTEM DIAGNOSIS AND REPAIR Understand, apply, and evaluate the diagnostic and repair techniques for the A/C system according to the manufacturer's specifications.	1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. 2. Identify and interpret heating and air conditioning concerns; determine necessary action. 3. Form teams and research applicable vehicle and service information, such as heating and air conditioning system operation, vehicle service history, service precautions, and technical service bulletins. 4. Locate and interpret vehicle and major component identification numbers. 5. Demonstrate how to conduct a performance test on an A/C system; identify, repair, and replace A/C system malfunctions. 6. Identify abnormal operating noises in the A/C system; determine necessary action: a. worn out bearings, hoses, belt, and pulleys	**Career Ready Practice:** 1, 2, 4, 5, 9, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.1, 4.2, 4.5 Problem Solving & Critical Thinking: 5.2 Leadership & Teamwork: 9.3, 9.7 Demonstration & Application:

(25 hours)	b. a/c clutches c. a/c compressor d. fan clutch 7. Identify refrigerant type; select and connect proper gauge set; record temperature and pressure readings: a. HFC-134a b. R1234YF 8. Leak test A/C system; determine necessary action. 9. Inspect the condition of refrigerant oil removed from the system; determine necessary action: a. Polyol Ester (POE) b. Polyalkylene Glycol (PAG) c. mineral oil 10. Determine recommended oil and oil capacity for system application. 11. Using a scan tool, observe and record related HVAC data and trouble codes. 12. Pass an a/c system diagnosis and repair assessment with an 80% score or higher.	11.1 **CTE Pathway:** C3.2, C3.7, C4.1, C4.3, C4.4, C5.6, C7.5
H. REFRIGERATION SYSTEM DIAGNOSIS AND REPAIR Understand, apply, and evaluate the diagnostic and repair techniques for the refrigeration system components according to the manufacturer's specifications.	1. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and PCM) to interrupt system operation; determine necessary action. 2. Inspect and replace A/C compressor drive belts, pulleys, and tensioners; determine necessary action. 3. Demonstrate how to inspect, test, and/or replace A/C compressor clutch components and/or assembly; check compressor clutch air gaps and adjust as needed. 4. Form teams and remove, inspect, and reinstall A/C compressor and mountings; determine required oil quantity. 5. Identify hybrid vehicle A/C system electrical circuits, service, and safety precautions. 6. Determine the need for an additional A/C system filter; perform necessary action. 7. Remove and inspect A/C system mufflers, hoses, lines, fittings, O-rings, seals, and service valves; perform necessary action. 8. Inspect A/C condenser for airflow restrictions; perform necessary action. 9. Remove, inspect, and reinstall receiver/drier or accumulator/drier; determine required oil quantity.	**Career Ready Practice:** 1, 2, 4, 5, 9, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.2 Problem Solving & Critical Thinking: 5.2, 5.3, 5.4 Leadership & Teamwork: 9.3, 9.7 Demonstration & Application: 11.1 **CTE Pathway:** C2.2, C3.2, C3.7, C4.1, C7.5

(25 hours)	10. Remove, inspect, and install expansion valve or orifice (expansion) tube. 11. Inspect evaporator housing water drain; perform necessary action. 12. Remove, inspect, and reinstall evaporator; determine required oil quantity. 13. Remove, inspect, and reinstall condenser; determine required oil quantity. 14. Locate refrigeration system leaks using dyes and electronic leak detection devices. 15. Pass a refrigeration system diagnosis and repair assessment with an 80% score or higher.	
I. HEATING, VENTILATION, AND ENGINE COOLING SYSTEMS DIAGNOSIS AND REPAIR Understand, apply, and evaluate the diagnostic and repair techniques for the heating, ventilation, and engine cooling systems according to the manufacturer's specifications. (25 hours)	1. Diagnose temperature control problems in the heater/ventilation system; determine necessary action. 2. Demonstrate how to perform cooling system pressure tests; inspect and test radiator, cap (pressure/vacuum), coolant recovery tank, and hoses; perform necessary action. 3. Explain the different antifreeze types, coolant level, and freezing/ boiling point; drain and recover coolant. 4. Form teams to inspect engine cooling and heater system hoses and belts; perform necessary action. 5. Inspect, test, and replace thermostat and gasket/seal. 6. Flush system; refill system with recommended coolant; bleed system. 7. Inspect and test cooling fan, fan clutch, fan shroud, and air dams; perform necessary action. 8. Inspect and test electric cooling fan, fan control system and circuits; determine necessary action. 9. Inspect and test heater control valve(s); perform necessary action. 10. Form teams to remove, inspect, and reinstall heater core. 11. Pass a heating, ventilation and engine cooling systems diagnosis and repair assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 4, 5, 9, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.2 Problem Solving & Critical Thinking: 5.2, 5.3 Leadership & Teamwork: 9.3, 9.7 Demonstration & Application: 11.1 **CTE Pathway:** C2.2, C3.2, C4.1, C7.5
J. OPERATING SYSTEMS AND RELATED CONTROLS DIAGNOSIS AND REPAIR	1. Demonstrate how to diagnose malfunctions in the electrical controls of heating, ventilation, and A/C (HVAC) systems; determine necessary action.	**Career Ready Practice:** 1, 2, 4, 5, 9, 10

Understand and evaluate the diagnostic and repair techniques for the operating systems and related controls according to the manufacturer's specifications. (25 hours)	2. Form teams to inspect and test A/C heater blower, motors, resistors, switches, relays, wiring, and protection devices; perform necessary action. 3. Test and diagnose A/C compressor clutch control systems; determine necessary action. 4. Diagnose malfunctions in the vacuum, mechanical, and electrical components and controls of the heating, ventilation, and A/C (HVAC) system; determine necessary action. 5. Inspect and test A/C heater control panel assembly; determine necessary action. 6. Inspect and test A/C heater control cables, motors, and linkages; perform necessary action. 7. Form teams to inspect A/C heater ducts, doors, hoses, cabin filters and outlets; perform necessary action. 8. Identify the source of A/C system odors. 9. Check operation of automatic or semi-automatic heating, ventilation, and air-conditioning (HVAC) control systems; determine necessary action. 10. Pass an operating systems and related controls diagnosis and repair assessment with an 80% score or higher.	**CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.2 Problem Solving & Critical Thinking: 5.2, 5.3, 5.4 Leadership & Teamwork: 9.3, 9.7 Demonstration & Application: 11.1 **CTE Pathway:** C2.2, C2.3, C3.2, C3.3, C3.5, C3.7, C5.6, C7.1, C7.5, C7.7
K. REFRIGERANT RECOVERY, RECYCLING, AND HANDLING Understand, apply, and evaluate the recovery, recycling, and handling techniques for the refrigerant according to the manufacturer's specifications.	1. Demonstrate how to perform correct use and maintenance of refrigerant handling equipment according to equipment manufacturer's standards. 2. Form teams to identify and recover A/C system refrigerants. 3. Demonstrate how to perform a vacuum and pressure leak test on a refrigeration system. 4. Explain the process to recycle, label, and store refrigerant. 5. Form teams to evacuate and charge the A/C system; add refrigerant oil as required. 6. Discuss license requirements in order to work on an A/C system. 7. Pass a refrigerant recovery, recycling, and handling assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 4, 5, 9, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.2 Problem Solving & Critical Thinking: 5.2, 5.3, 5.4 Leadership & Teamwork: 9.3, 9.7 Technical Knowledge & Skills: 10.1

(25 hours		Demonstration & Application: 11.1 **CTE Pathway:** C1.1, C1.3, C4.1, C5.2, C5.3, C5.6, C7.5
L. EMPLOYABILITY SKILLS AND RESUME PREPARATION Understand, apply, and evaluate the employability skills and resume preparation desired of automotive technicians.	1. Understand and define employer requirements for soft skills such as: a. attitude toward work b. communication and collaboration c. critical thinking, problem solving, and decision-making d. customer service e. diversity in the workplace f. flexibility and adaptability g. interpersonal skills h. leadership and responsibility i. punctuality and attendance j. quality of work k. respect, cultural and diversity differences l. teamwork m. time management n. trust and ethical behavior o. work ethic 2. Develop a career plan that reflects career interests, pathways, and post-secondary options. 3. Create/revise a resume, cover letter and/or portfolio. 4. Demonstrate, analyze, research, and review the role of online job searching platforms and career websites to make informed decisions. 5. Understand the importance of assessing social media account content for professionalism. 6. Demonstrate and complete and/or review an on-line job application.	**Career Ready Practice:** 1, 2, 3, 4, 5, 7, 8, 9, 10, 11 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.4. 2.5 Career Planning & Management: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.8, 3.9 Technology: 4.1, 4.2, 4.3, 4.5 Problem Solving & Critical Thinking: 5.1, 5.4 Responsibility & Flexibility: 7.2, 7.3, 7.4, 7.7 Ethics & Legal Responsibilities: 8.3, 8.4, 8.5 Leadership & Teamwork: 9.1, 9.2, 9.3, 9.4, 9.6, 9.7 Technical Knowledge & Skills: 10.1, 10.3 Demonstration & Application: 11.1, 11.2, 11.5

(4 hours)	7. Understand and demonstrate interview skills to get the job: a. do's and don'ts for job interviews b. how to dress for the job 8. Demonstrate and create sample follow-up letters. 9. Understand the importance of the continuous upgrading of job skills as it relates to: a. certification, licensure, and/or renewal b. professional organizations/events c. industry associations and/or organized labor	**CTE Pathway:** C5.4, C5.5
M. ENTREPRENEURIAL SKILLS Understand, apply, and evaluate the process involved in becoming an entrepreneur in the automotive industry. (5 hours)	1. Define entrepreneurship. 2. Identify and research the necessary characteristics of successful entrepreneurs. 3. Examine personal goals prior to starting a business. 4. Evaluate sources of monetary investment in a business opportunity. 5. Explain licensing/permit requirements for a business. 6. Explain how the Small Business Administration (SBA) assists entrepreneurs with lenders and funding to help them plan, start and grow a business. 7. Demonstrate a budget to identify start-up expenses. 8. Pass an entrepreneurial skills assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 4, 10, 11 **CTE Anchor:** Academics: 1.0 Communications: 2.1, 2.3, 2.5 Technology: 4.1, 4.2, 4.5 Responsibility & Flexibility: 7.1, 7.6 Technical Knowledge & Skills: 10.1, 10.3, 10.4 Demonstration & Application: 11.1, 11.2, 11.3, 11.4, **CTE Pathway:** C5.1, C5.2, C5.3, C5.5

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