HVAC Systems for Cars & Automotive Vehicles

An Online Continuing Education Course for Engineers

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A vehicle Heating Ventilation and Air Conditioning (HVAC) system is not just desirable but is necessary standard equipment even in entry-level vehicles manufactured today. The desire for even more comfort and luxury has led to the development of automatic climate control systems available for luxury models.

The primary purpose of HVAC systems is to provide a comfortable ride for the driver and onboard passengers. In addition to providing a comfortable ride, the air conditioner also dehumidifies the cabin air, thus preventing windows from fogging up. They also play a key role in terms of safety. Even during extreme conditions, it provides safety by ensuring the demisting of the cab environment and defogging of windows in all kinds of weather.

HVAC in passenger cars is a complex system comprising one or more blower motors coupled with many ducts through which air is transferred to the cabin, actuators for airflow, temperature and fogging control, and refrigeration and heating unit in the hood. This course provides an overview of automotive HVAC systems and approaches to climate control systems. This course can be used either as induction, awareness, or refresher training. This course will be beneficial to anyone interested or working with refrigeration, air conditioning and heating, and mobile air conditioning systems.

Learning Objectives

- Explain refrigeration fundamentals
- Describe the difference between the high and low sides of the system
- List the major heating and air-conditioning components and their operation
- Describe different types of refrigeration compressors
- Identify the automatic sensors and safety devices used
- Describe the features of an automatic climate control system
- Learn the different types of refrigerants, environmental regulations, and challenges
- Perform diagnosis of common problems
- Understand the repair and troubleshooting techniques.

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6.0. Chapter 6: Evaluating and Diagnosing Car HVAC

1.0. Chapter 1: Basic Principles of Air-Conditioning

The basic purpose of heating, ventilation, and air conditioning (HVAC) systems in vehicle air conditioning is not only to add heat or remove the unwanted heat from the passenger cabin but also to purify and circulate air throughout the vehicle.

The operation of the HVAC system may be controlled either automatically or manually by the driver. In some high-end luxury vehicles, conditioned air distribution can be “zone” controlled for each seating position. The objective here is to provide a thermally comfortable environment for every passenger as per his or her requirements.

1.1 HVAC System

The acronym HVAC stands for Heating, Ventilation, and Air Conditioning. The automobile HVAC system can be thought of as a climate control system having three subsystems:

H	Heating
V	Ventilation
AC	Air Conditioning

1.1.1. Heating

The purpose of the heating system is to add heat in the winter. Heating the passenger compartment is a comparatively easy task since there is such an abundant supply of waste heat produced in the engine. This waste heat is expelled into the exhaust system and absorbed into the engine parts and oil. The heat that is absorbed by the engine parts must be removed, or the engine would fail in minutes. This is the job of the engine cooling system. We can tap into this heat source to provide heat to the passenger compartment.

1.1.2. Ventilation

The purpose of ventilation air is to keep the car interior fresh, replace stale air, prevent carbon monoxide from the exhaust, and create positive cabin pressure. The air ducts allow outside air into the interior via a cabin filter to clean the air by trapping dust and pollen particles before they enter the passenger compartment.

1.1.3. Air Conditioning and Dehumidification

Air conditioning cooling is provided by a vapor compression refrigeration system. The automotive air conditioner combines the refrigeration system with an air distribution system and a temperature-control system to cool, clean, and dehumidified air.

The automobile compartment is heated due to several factors such as:

a. Higher temperature of outside air
b. Solar radiation
c. Engine/exhaust heat

The amount of heat absorbed is dependent upon:

a. Automobile insulation
b. Position of sun and intensity of solar radiation
c. Variation of light and shadow
d. Vehicle color
e. Tinted glass
f. Vehicle speed
g. Wind direction and velocity

The cabin passengers also contribute to

The automobile a heat inputs. Heat load on the air conditioner 18000 Btu/hr, which is equivalent to 1.5 t nducted through the body metal and glass, a arts within the compartment. The heat at engine idle, and hence, full air condi

Besides temperature n many cases, it is an even more important is also one of the requirements of air c aporator fins just as it would on a glass hold off the evaporator and runs out the drain at t pecially useful if it rains outside.

The two main sources

a. Outside air
b. Breathing of passengers