ROHINI COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS INSTITUTION
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

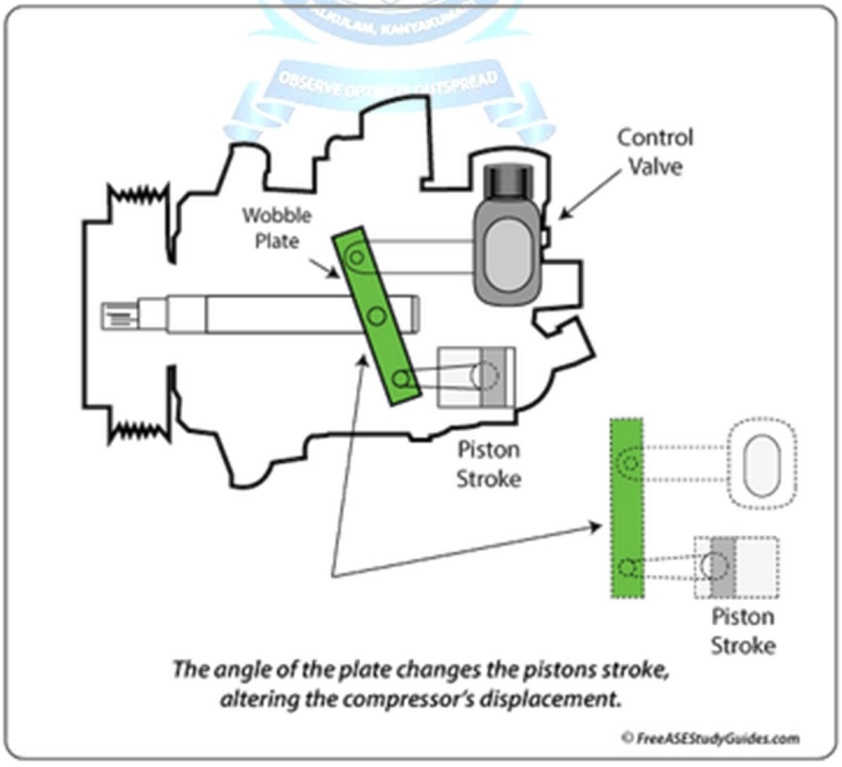
VII Semester

AU3008 Sensors and Actuators

UNIT – 5 - AUTOMATIC TEMPERATURE CONTROL ACTUATORS

5.3 Semi-Automatic- Controller design for Fixed and variable displacement type air conditioning system.

- Designing a semi-automatic controller for fixed and variable displacement air conditioning systems involves integrating control logic and hardware that optimizes system performance while balancing user inputs and automatic adjustments. Below is an outline to approach this design:



1. System Overview:

Fixed Displacement Compressor:

- ❒ Operates at a constant capacity irrespective of load conditions.
- ❒ Cooling output is controlled primarily by cycling the compressor on and off.

Variable Displacement Compressor:

- ❒ Adjusts its displacement to match cooling demand, improving efficiency.
- ❒ Uses internal mechanisms (e.g., a swashplate or wobble plate) to vary the stroke of the pistons.

2. Semi-Automatic Controller Features

- ❒ **User Control:**
  - ➢ Allow the user to set desired temperature and fan speed.
  - ➢ Manual override for compressor cycling (fixed) or displacement level (variable).
- ❒ **Automatic Adjustments:**
  - ➢ Monitor cabin temperature and adjust cooling intensity to maintain the desired setpoint.
  - ➢ Automatically regulate compressor cycling (fixed) or displacement (variable) based on load.

3. System Components

- ❒ **Sensors:**
  - ➢ Cabin temperature sensor (thermistor or RTD).
  - ➢ Ambient temperature sensor.
  - ➢ Pressure transducers for refrigerant pressure.
  - ➢ Displacement feedback sensor (for variable compressors).
- ❒ **Actuators:**
  - ➢ Solenoid for fixed compressor clutch engagement.
  - ➢ Variable displacement control valve (proportional solenoid) for variable compressors.
- ❒ **Controller Hardware:**

- Microcontroller or embedded system with ADC for sensor input.
- H-bridge or relay drivers for solenoid actuation.

❒ **User Interface:**

- Rotary knobs or digital buttons for temperature and fan speed control.
- Display for temperature setpoint and status indicators.

4. Control Logic

❒ **Fixed Displacement Compressor**

1. Compare the setpoint and cabin temperature.
2. If the cabin temperature exceeds the setpoint:
   - Engage the compressor clutch.
3. If the cabin temperature falls below the setpoint:
   - Disengage the clutch.
4. Add a time delay to prevent frequent cycling (anti-short-cycling logic).

❒ **Variable Displacement Compressor**

1. Continuously monitor cabin temperature and calculate the error (setpoint - actual temperature).
2. Use a proportional-integral-derivative (PID) controller to determine the required compressor displacement.
3. Adjust the displacement control valve to modulate refrigerant flow and meet cooling demand.

5. Implementation Steps

❒ **Hardware Prototyping:**

- Select suitable sensors and actuators.
- Design and fabricate the PCB for the controller.

❒ **Software Development:**

- Develop control algorithms (e.g., PID) for temperature regulation.
- Implement a user interface module for setpoint configuration.

❒ **System Integration:**

- Calibrate sensors and actuators.

- Test the system under various conditions (temperature, load, etc.).

❒ **Safety Features:**

- High-pressure cutoff to protect the system.
- Overheat protection for the compressor.

6. Advantages of Semi-Automatic Control

- Provides a balance between user intervention and automated performance optimization.
- Enhances energy efficiency and comfort compared to fully manual systems.
- Reduces wear and tear on components by intelligently managing operation cycles.

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