Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

Department of Research & Development

Mid - Term Examinations - AUGUST 2024

Odd Semester: Ph.D. Course Work
Course Code: MEC 820
Course Name: Advanced refrigeration and air conditioning
Department: Mechanical Engineering

Date: 12-08-2024
Time: 02.00pm to 03.30pm
Max Marks: 50
Weightage: 25%

Instructions:

(i) Read all questions carefully and answer accordingly.
(ii) Make suitable assumptions wherever required with justification.
(iii) ***Books, notes and data handbooks are allowed.***

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1. **a.** A domestic refrigerator with a refrigerating capacity of 150 W operates on a simple saturation cycle with evaporator and condenser temperatures of -25°C and 55°C, respectively. Perform the following analyses for refrigerants R 290, R 134a, R 152a, and R 600a:

- Calculate and compare the following parameters for each refrigerant:
- Specific volume of suction vapor
- Refrigerating effect
- Mass flow rate
- Discharge pressure and temperature
- Piston displacement
- Power consumption
- Coefficient of performance (COP)
- Pressure drops across the capillary tube

b. Consider a scenario where the refrigerator designed for R 134a is charged with propane (R 290) without changing the hermetic compressor. Calculate the following under the same operating conditions, ignoring the effect on the capillary:

- Motor wattage required
- Isentropic discharge temperature
- Heat required to be rejected in the condenser
- Determine the refrigerating capacity of the refrigerator when operating with propane

c. Discuss the implications of charging an R 134a refrigerator with propane in terms of performance and safety. **[30 M]**

(CO:01 BL: Analyze)

2. An ammonia ice plant operates on a simple saturation cycle with a condensing temperature of 40°C and an evaporating temperature of -15°C. The plant produces 10 tons of ice per day at -5°C from water initially at 30°C. Using this data, perform the following analyses:

- **Determine the Capacity of the Refrigeration Plant:**
  Calculate the refrigeration capacity required to produce 10 tons of ice per day under the given conditions.
- **Calculate the Mass Flow Rate of Refrigerant:**
  Determine the mass flow rate of ammonia needed to achieve the specified refrigeration capacity.
- **Find the Isentropic Discharge Temperature:**
  Calculate the isentropic discharge temperature of the refrigerant under the given cycle conditions.
- **Compressor Dimensions (Bore and Stroke):**
  If the compressor runs at 1400 rpm with a volumetric efficiency of 65% and a stroke-to-bore ratio (L/D) of 1.2, calculate the bore and stroke dimensions of the compressor.
- **Compressor Horsepower:**
  Determine the horsepower required for the compressor, given an adiabatic efficiency of 85% and a mechanical efficiency of 95%.
- **Coefficient of Performance (COP):**
  Calculate both the theoretical and actual COP of the refrigeration cycle.

Discuss how the operating conditions and efficiencies impact the performance and efficiency of the ice plant.

[20 M]
(CO:02 BL: Analyze)