

**R18**

**Code No: 157DK**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B. Tech IV Year I Semester Examinations, December-2023/January-2024**

**REFRIGERATION AND AIR CONDITIONING**

**(Mechanical Engineering)**

**Time: 3 Hours**

**Max. Marks: 75**

**Note:** i) Question paper consists of Part A, Part B.

ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.

iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

**PART – A**

**(25 Marks)**

- 1.a) What is the difference between expander and compressor? [2]
- b) Explain the cycle of Carnot refrigerator. [3]
- c) Explain the effect of condenser pressure on the efficiency of the cycle. [2]
- d) What are the variations of actual cycle compared? [3]
- e) Differentiate between expansion cylinder and expansion valve. [2]
- f) What are the properties of ideal refrigerant? [3]
- g) What are the properties of refrigerant and absorbant combination? [2]
- h) What is the working principle of Vortex tube refrigerator? [3]
- i) What is the meaning of air conditioning? [2]
- j) Explain the relation between wet bulb temperature, sensible heaters, sensible cooling. [3]

**PART – B**

**(50 Marks)**

- 2.a) Draw neat sketches of plant lay out and T-S Plot of regenerative air cooling system.
  - b) What are the advantages of dense air refrigeration system over an open air refrigerating system?
  - c) Why artificial cooling is required in aero planes? And what are the different systems used for cooling the aero planes? [4+3+3]
- OR**
- 3.a) Define the following terms of refrigeration
    - i) Refrigerating effect
    - ii) Ton of refrigeration
    - iii) COP
    - iv) Refrigerator and heat pump.
  - b) A refrigerator works on the Carnot cycle between the temperatures  $-7^{\circ}\text{C}$  and  $27^{\circ}\text{C}$ . It makes 500 kg of ice per hour at  $-5^{\circ}\text{C}$  from water at  $14^{\circ}\text{C}$ . Find power required to drive the compressor and COP of the cycle. Take specific heat of ice as  $2.4 \text{ kJ/kg}^{\circ}\text{C}$  and latent heat  $334.4 \text{ kJ/kg}$ . [5+5]

- 4.a) What is the effect of super heating and sub cooling of refrigerants?  
b) A refrigerator using Ammonia works between the temperatures  $-10^{\circ}\text{C}$  and  $0^{\circ}\text{C}$ . The gas is dry at the end of compression and there is no under cooling of liquid. Using the tables, Calculate the theoretical COP of the cycle. [5+5]

**OR**

5. A simple vapour compression cycle using F-12 is designed to take a load of 10 tons. The refrigerator and ambient temperatures are  $0^{\circ}\text{C}$  and  $30^{\circ}\text{C}$  respectively. A minimum temperature of  $-5^{\circ}\text{C}$  is required in evaporator and condenser for heat transfer. Find  
a) Mass flow rate through the system  
b) Power required in kW  
c) Cylinder dimensions assuming L/D ratio as 1.2 for a single cylinder and single acting compressor running at 300 RPM with a volumetric efficiency of 0.9. [3+4+3]

- 6.a) With the help of a schematic diagram, explain the function of Evaporators used in refrigeration.  
b) Explain the working of a automatic expansion valve with the help of a neat sketch.[5+5]

**OR**

- 7.a) Define primary refrigerant and discuss desirable properties of primary refrigerants. Give the refrigerant number for the following:  $\text{CHClF}_2$ ,  $\text{C}_2\text{H}_6$ ,  $\text{CO}_2$ ,  $\text{CH}_2\text{F}-\text{CF}_3$   
b) "A completely odourless refrigerant is not desirable", discuss the statement. [5+5]

- 8.a) Draw the line diagram and explain the working of practical vapour absorption system.  
b) Discuss the advantages and limitations of vapour absorption refrigeration system over Vapour compression refrigeration system. [5+5]

**OR**

- 9.a) Explain with the help of a neat sketch, the working of a steam jet refrigeration system.  
b) Explain the difference between n-type and p-type semi-conductors. Which are more useful for thermoelectric refrigeration system? [5+5]

- 10.a) Illustrate with an example how heat pump can be used for de humidification process.  
b) Write notes on electrically driven heat pump for heating and cooling. [5+5]

**OR**

11. Room conditions:  $26^{\circ}\text{C}$  DBT,  $19^{\circ}\text{C}$  WBT  
Outside conditions:  $35^{\circ}\text{C}$  DBT,  $27^{\circ}\text{C}$  WBT  
Room heat gains:  
Sensible heat: 11.1 kW  
Latent heat: 3.9 kW  
The conditioned air supplied to the room is 50 cm and 25% fresh air and 75% recirculated room air. Determine the following.  
a) The DBT and WBT of supply air.  
b) The DBT and WBT of mixed fresh and recirculated air before the cooling coil.  
c) The apparatus dew point and bypass factor of the coil.  
d) The refrigeration load on the cooling coil and the moisture removed by the coil.[2+2+3+3]