

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh semester B.Tech examinations (S), September 2020

Course Code: ME405**Course Name: REFRIGERATION AND AIR CONDITIONING**

Max. Marks: 100

Duration: 3 Hours

*Use of chart and tables are permitted***PART A***Answer any three full questions, each carries 10 marks.*

Marks

- 1 a) Prove that $COP_{\text{Heat Pump}} = COP_{\text{Refrigerator}} + 1$. Use necessary sketches to justify your answer. (5)
- b) What are the limitations of reversed Carnot cycle? What is the significance of Carnot cycle? (5)
- 2 With the help of the schematic, T-s and P-h diagrams describe the working of a simple vapour compression refrigeration system. Also write down the expressions to find out the Capacity, Compressor work and COP of the system. (10)
- 3 The cooling load of a new Boeing aeroplane is 10 Tonnes. A boot strap cooling system is proposed. The temperature and pressure conditions of the atmospheric air are 20°C and 0.9 bar. The cabin pressure is 1.02 bar and temperature of air leaving the cabin should be greater than 25°C. The pressure of air will be increased from 0.9 bar to 1.1 bar due to ramming and this process is considered isentropic. The pressures of air leaving the main and auxiliary compressor will be 3 bar and 4 bar respectively. Isentropic efficiency of compressors and turbine to be used are 0.85 and 0.8 respectively. It is considered that 50% of the total heat of air leaving the main compressor is removed in the first heat exchanger and 30% of the total heat of air leaving the auxiliary compressor is removed in the second heat exchanger. Calculate 1) the power required to take heat load of the cabin and 2) the COP of the system. (10)
- 4 A vapour-compression refrigeration system use Refrigerant 134a as the working fluid. The R134a flow rate is 6 kg/min. The refrigerant enters the compressor at -10°C and 1.4 bar. The isentropic compressor efficiency is 70%. The refrigerant leaves the condenser at 24°C and 7 bar. There are no (10)

appreciable pressure drops as the refrigerant flows through the condenser and evaporator. Ignoring heat transfer between the compressor and its surroundings and the pressure drops in condenser and evaporator, determine (a) the COP and (b) the refrigerating capacity in TR.

PART B

Answer any three full questions, each carries 10 marks.

- 5 What are the desirable properties of refrigerants? Write a short note on eco-friendly refrigerants. (10)
- 6 a) Describe the working of a water cooler based on simple vapour compression refrigeration cycle using a schematic diagram. (5)
- b) What is called 'charging of refrigerant'? Point out minimum two ways to perform it? Mention minimum two methods for the leak detection of refrigerants. (5)
- 7 How a two stage multi pressure system with flash intercooling is different from the system with flash gas removal alone. Show the differences using the schematic and P-h diagrams. (10)
- 8 What are the different types of Evaporators used in refrigeration system? Describe with a neat sketch minimum two types of evaporators commonly used. (10)

PART C

Answer any four full questions, each carries 10 marks.

- 9 Define the psychrometric terms: i) DBT ii) WBT iii) DPT iv) Specific humidity v) Relative Humidity. Describe and show the following processes on a representative psychrometric chart: a) Sensible cooling and humidification and b) Heating and dehumidification and c) sorbent dehumidification. (10)
- 10 a) With the help of schematic diagram describe the working of winter air conditioning system. (5)
- b) What is the function of thermostat in a refrigeration system? How does it work? Describe the working of any one type of humidistat widely used in refrigeration practices. (5)
- 11 Air at 32 °C DBT and 70% RH is cooled and dehumidified to the following conditions: 1) 20 °C and 70% RH, 2) 22 °C and 50% RH and 3) 24 °C and 30% RH. If the air flow rate of air is 600 litres/sec, find out the heat absorbed in kW and moisture removed in g/s for the three conditions. (10)

- 12 a) With the help of schematic diagram describe the working of year round air conditioning system (5)
- b) Differentiate between all air and air water system (5)
- 13 A summer AC is operating using 100% ventilation are without any recirculation. The outside air is at 35 °C DBT and 45% RH. The conditioned room is maintained at 25 °C DBT and 45% RH. The flow rate of air is 0.95 m³/s and The SHR of the room is 0.72. The air leaving the cooling coil is 90% saturated and rest 10% is bypassed. Determine 1) the apparatus dew point and the temperature of the air leaving the coil, 2) How much cooling in kW is the unit doing? and 3) How much moisture in kg/kg of dry air is condensed out of the incoming air per hour? (10)
- 14 Describe the important factors to be considered while designing an air conditioning system for 1) cinema theatres and 2) hospitals with schematic representations (10)
