Hall Ticket No | | | | | | | | | | |

Question Paper Code: AMEB31

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

B.Tech VII SEMESTER END EXAMINATIONS (REGULAR/SUPPLEMENTARY) - DECEMBER 2022
Regulation: R18

REFRIGERATION AND AIR-CONDITIONING

Time: 3 Hours **(MECHANICAL ENGINEERING)** **Max Marks: 70**

Answer FIVE Questions choosing ONE question from each module
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) Obtain an expression for COP of reversed Carnot cycle and clearly explain all the processes. [BL: Apply| CO: 1|Marks: 7]

   (b) Ice is formed at 0°C from water at 20°C. The temperature of the brine is – 8°C. Find out the kg of ice formed per kWh. Assume that the refrigeration cycle used is perfect reversed Carnot cycle. Take latent heat of ice as 335 kJ/kg.. [BL: Apply| CO: 1|Marks: 7]

2. (a) Classify various refrigeration systems and discuss any one refrigeration system, mentioning its application. [BL: Understand| CO: 1|Marks: 7]

   (b) A cold storage plant is required to store 20 tonnes of fish. The temperature of the fish when supplied = 25°C ; storage temperature of fish required = – 8°C ; specific heat of fish above freezing point = 2.93 kJ/kg-°C ; specific heat of fish below freezing point = 1.25 kJ/kg°C ; freezing point of fish = – 3°C. Latent heat of fish = 232 kJ/kg. If the cooling is achieved within 8 hours. Find
   i) Capacity of the refrigerating plant.
   ii) Carnot cycle COP between this temperature range
   iii) If the actual COP is 1/3 rd of the Carnot COP, find out the power required to run the plant. [BL: Apply| CO: 1|Marks: 7]

MODULE – II

3. (a) How does an actual vapour compression cycle differ from that of a theoretical cycle? Compare vapour compression and vapour absorption refrigeration systems. [BL: Understand| CO: 2|Marks: 7]

   (b) A simple vapour compression plant produces 5 tonnes of refrigeration. The enthalpy values at inlet to compressor, at exit from the compressor, and at exit from the condenser are 183.19, 209.41 and 74.59 kJ/kg respectively. Estimate
   i) The refrigerant flow rate
   ii) The C.O.P
   iii) The power required to drive the compressor
   iv) The rate of heat rejection to the condenser. [BL: Apply| CO: 2|Marks: 7]

4. (a) Draw the schematic of a simple vapour compression cycle and explain its working principle [BL: Understand| CO: 2|Marks: 7]

(b) 28 tonnes of ice at 0°C is produced per day in an ammonia refrigerator. The temperature range in the compressor is from 25°C to – 15°C as shown in Table 1. The vapour is dry and saturated at the end of compression and an expansion valve is used. Assuming a co-efficient of performance of 62% of the theoretical, calculate the power required to drive the compressor.

[BL: Apply| CO: 2|Marks: 7]

Table 1

Temperature	Enthalphy KJ/kgK		Entropy of liquid KJ/kgK	Entropy of vapour KJ/kg
	Liquid	Vapour		
25	100.04	1319.22	0.3473	4.4852
-15	-54.56	1304.9	-2.1333	5.0582

MODULE – III

5. (a) Illustrate the working of following types of evaporators with neat sketches:

i) Flooded evaporator ii) Natural convection evaporator [BL: Understand| CO: 3|Marks: 7]

(b) 1 m^3 of a gas is compressed adiabatically ($\gamma = 1.4$) from 1 bar to 5 bar in a reciprocating compressor with 8 per cent clearance. If the exponent of the re-expansion curve is 1.1 instead of 1.4, find the percentage increase in the work of compression. [BL: Apply| CO: 3|Marks: 7]

6. (a) Outline the working principle of evaporative condenser with a neat sketch. Give the comparison between air cooled and water cooled condenser. [BL: Understand| CO: 4|Marks: 7]

(b) An R 134a Thermostatic-expansion valve, not equipped with an external equalizer, has a superheat setting of 7°C while supplying the refrigerant to the evaporator at 0°C. The power fluid is the same as the refrigerant.

i) Determine the difference in pressure on opposite sides of the diaphragm or bellows required to open the valve.

ii) If the temperature at the evaporator inlet is –5°C and the pressure drop through the coil is 0.3 bar, what is the degree of superheat of the suction gas leaving the evaporator?

[BL: Apply| CO: 4|Marks: 7]

MODULE – IV

7. (a) What do you understand by psychrometric chart and interpret the various lines on it with the help of figure. [BL: Understand| CO: 5|Marks: 7]

(b) Calculate i) Relative humidity ii) Humidity ratio iii) Dew point temperature iv) Density

v) Enthalpy of atmospheric air when the DBT is 35°C, WBT is 23°C and the barometer reads 750 mm Hg. [BL: Apply| CO: 5|Marks: 7]

8. (a) Describe winter air conditioning system. Summarize the procedure for calculating cooling load due to infiltration air. [BL: Understand| CO: 5|Marks: 7]

(b) The air-handling unit of an air-conditioning plant supplies a total of 4500 cmm of dry air which comprises by weight 20 per cent fresh air at 40°C DBT and 27°C WBT, and 80 per cent recirculated air at 25°C DBT and 50 per cent RH. The air leaves the cooling coil at 13°C saturated state. Calculate the total cooling load, and room heat gain. [BL: Apply| CO: 5|Marks: 7]

MODULE – V

9. (a) Summarize the usage of "heat pump" for heating and cooling cycle with neat diagrams. [BL: Understand| CO: 6|Marks: 7]

   (b) With the help of a diagram, illustrate the air washer humidifier and state the advantages of this type. [BL: Understand| CO: 6|Marks: 7]

10. (a) Explain in brief the following with a neat diagram:
    i) Filters ii) Humidifiers used in air conditioning systems. [BL: Understand| CO: 6|Marks: 7]

    (b) Apply the Bernoulli's equation for ducts and obtain the expression for a capacity of a duct. [BL: Apply| CO: 6|Marks: 7]

– ○ ○ ◯ ○ ○ –