C 1079 (Pages : 4) Name.....

Reg. No.....

EIGHTH SEMESTER B.TECH. (ENGINEERING) [09 SCHEME] DEGREE EXAMINATION, APRIL 2016

ME 09 801—REFRIGERATION AND AIR-CONDITIONING

Time : Three Hours Maximum : 70 Marks

Part A

Answer **all** *the questions.*

Each question carries 2 *marks.*

1. Define the term 'refrigeration capacity' and 'coefficient of performance' in relation to a refrigeration system.
2. Distinguish between dry and wet compression. What are the advantages of one over the other ?
3. List out the relative merits of vapour absorption and vapour compression refrigeration systems.
4. Define the terms DBT, WBT and RH.
5. What are the different types of water-cooled condensers ?

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

Each question carries 5 *marks.*

6. A refrigerator working on Bell-Coleman cycle operates between pressure limits of 1.05 bar and 8.5 bar absolute. Air is drawn from the cold chamber at 10°C. Air coming out of compressor is cooled to 30°C before entering the expansion cylinder. Expansion and compression follow the law $pv^{1.35}$ = constant. Determine theoretical C.O.P. of the system.
7. In an absorption type refrigerator, the heat is supplied to NH_3 generator by condensing steam at 2 bar and 90 % dry. The temperature to be maintained in the refrigerator is – 5 °C. The temperature of the atmosphere is 30°C. Find the maximum C.O.P. possible of the refrigerator.

   If the refrigeration load is 20 tons and actual C.O.P. is 70 % of maximum C.O.P., find the mass of steam required per hour. Assume only latent heat of steam is used for heating purposes.
8. 20 m^3 of air per minute at 30°C and 60 % RH is cooled to 22°C DBT maintain specific humidity constant. Find the following (i) Heat removed from air ; (ii) R.H. of cooled air ; (iii) WBT of the cooled air. Take air pressure = 1 bar.

Turn over

9. The air-handling unit of an air-conditioning plant supplies a total of 4500 cmm. of dry air which comprises by weight 20 percent fresh air at 40°C DBT and 27°C WBT, and 80 percent recirculated air at 25°C DBT and 50 percent RH. The air leaves the cooling coil at 13°C saturated state. Calculate the total cooling load, and room heat gain.

10. A reciprocting compressor of a refrigeration machine works between 2 bar and 12 bar. The clearance is 6 % of the stroke. Adiabatic compression and expansion follow the law $pv^{1.31}$ = constant. Find the power required to run the compressor if volume of gas sucked per minute is 1 m^3. Also find the volumetric efficiency of the compressor.

11. Where air-cooled condensers are preferred over water-cooled condensers ? Give *five* examples with specific reasons.

(4 × 5 = 20 marks)

Part C

Answer **all** *questions.*

12. (a) A dense closed cycle air-refrigeration system working between 4 bar and 16 bar extracts 120 MJ of heat per hour. The air enters the compressor at 5°C and into the expander at 20°C. Assuming the unit runs at 300 r.p.m. find : (a) kW required to run the unit, (b) bore of compressor, and (c) refrigerating capacity in tons of ice at 0°C per day.

Take the followings :

Compressor and expander are double acting and stroke for compressor and expander = 30 cm.

Mechanical efficiency of compressor = 80 %.

Mechanical efficiency of expander = 85 %.

Latent heat ice = 336 kJ/kg.

Assume the compression and expansion are isentropic.

(10 marks)

Or

(b) With net sketch explain the working principle of thermoelectric refrigeration and adiabatic demagnetization refrigeration system. List out the advantages and disadvantages.

(10 marks)

13. (a) A compound refrigeration system is shown in Fig. 1 for multi-load purposes. F^{-12} is used as refrigerant in the system. Find the followings :

(i) Power required to run the system.

(ii) C.O.P. of the whole system.

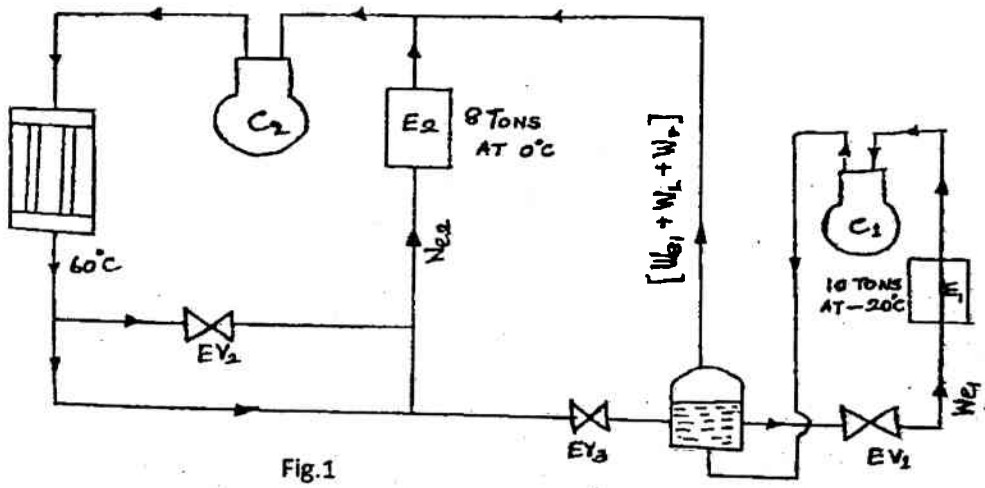

Fig.1

(10 marks)

Or

(b) Draw a neat compact diagram of lithium bromide water absorption refrigeration system and explain its working. List out the major field of application of this refrigeration system.

(10 marks)

14. (a) The outdoor dry-bulb and wet-bulb temperature are 40°C and 28°C respectively. The indoor design conditions in a laboratory are 25.5°C and 50 % relative humidity. The RSH and RLH are 70 kW and 40 kW respectively. There are 200 persons in the laboratory and ventilation requirement is 0.56 ccm. per person. Find the supply air state.

(10 marks)

Or

(b) In a winder air conditioning system, an air washer of 90 % efficiency is used with heated water followed by sensible heating by an electric heater. The indoor design conditions are 22°C and 50 % relative humidity. The outdoor design conditions are 0° and 70 % relative humidity. Room heat less is 200 kW and vapour loss may be neglected. The supply air and ventilation air rates are 800 cmm. and 500 cmm. respectively. The spray water flow rate is 150 kg/min. and make-up water is available at 20°C. Find the heat transfer in various processes.

(10 marks)

15. (a) **Explain the working of evaporative condenser with neat diagram and explain its advantages and disadvantages over other.**

(10 marks)

Or

(b) **Explain with a neat sketch the working principle of automatic expansion valve. Discuss the factors that affect the capacity of the valve.**

(10 marks)

[4 × 10 = 40 marks]