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Name .....

Reg. No .....

EIGHTH SEMESTER B.TECH. [ENGINEERING] (09 SCHEME) DEGREE EXAMINATION, APRIL 2015

ME 09 801—REFRIGERATION AND AIRCONDITIONING

Time : Three Hours

Maximum : 70 Marks

Part A

Answer **all** *questions.*

1. Define the term 'refrigeration capacity' and 'coefficient of performance' in relation to a refrigeration system.
2. Why artificial cooling is required in aeroplanes ?
3. List out the relative merits of vapour absorption and vapour compression refrigeration systems.
4. What are the important considerations in the design of air-conditioning system ?
5. What are the different types of water-cooled condensers ?

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

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. A simple saturation cycle using Freon 22 is designed for a load of 100 TR. The saturated suction and discharge temperatures are 5°C and 40°C respectively. Calculate : (a) The mass flow rate of refrigerant ; (b) The C.O.P.

   Use the following data :

t °C	p bar	h_f kJ/kg	h_g kJ/kg	s_f kJ/kg K	s_g kJ/kg K	v_g m^3/kg
5	5.836	205.9	407.1	1.02115	1.7447	0.0404
40	15.331	249.53	416.4	1.16659	1.69953	-

8. 20 m^3 of air per minute at 30°C and 60% RH is cooled to 22°C DBT maintaining 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.
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.

Turn over

10. A reciprocating 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. 1 m^3 of a gas is compressed adiabatically (γ = 1.4) from 1 bar to 5 bar in a reciprocating compressor with 8 percent 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.

(4 × 5 = 20 marks)

Part C

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 of ice = 336 kJ/kg

Assume the compression and expansion are isentropic.

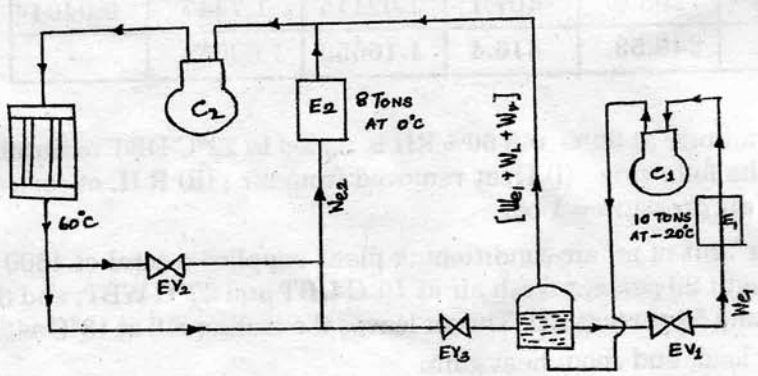
Or

(b) With neat sketch explain the working principle of Steam Jet Refrigeration system. What are the advantages and disadvantages of steam jet refrigeration system over other types of refrigeration system ?

13. (a) A compound refrigeration system is shown in Figure below 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.



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.

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.

Or

(b) In a winder airconditioning 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 loss 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.

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

Or

(b) Draw a line diagram to illustrate the control of dampers, cooling coils, heaters and fan with the help of thermostats and humidostats in case of all year airconditioning system.

(4 × 10 = 40 marks)