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B.E. (VIIIth Sem.) (CGPA) Mech, Engg. Exam.-2015

REFRIGERATION & AIR CONDITIONING

Paper : M-702

Time Allowed : Three Hours

Maximum Marks : 60

Note : Attempt any five questions.

All carry equal marks.

Use of refrigeration table and psychrometric chart is permitted.

Assume suitable data is necessary.

Q.I (a) How is the effectiveness of a refrigeration system measured ? Which cycle used in air-conditioning of aeroplanes, using air as a refrigerant. 4

(b) Prove that the performance factor of a

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Coleman cycle refrigeration system is given by—

$$C.O.P. = \frac{T_2}{T_3 - T_2}$$

Where T_2 and T_3 are the temperature of air at the inlet and discharge of compressor respectively. Explain the working of this cycle. 8

Q.II Draw and write about all the air refrigeration system used in different air-aviation industry. 12

Q.III A freezer of 20TR capacity has evaporator and condensor temperature of -30°C and 25°C respectively. The refrigerant R-12 is sub-cooled by 4°C before it enters the expansion valve and is superheated by 5°C before leaving the evaporator. The compression is isentropic and the valve throttling and clearance are to be neglected. If a six cylinder, single acting compression with stroke equal to bore running at 1000 rpm is used, determine (a) C.O.P. of the refrigerating system (b) mass of refrigerant to be circulated per min, (c) theoretical piston displacement per minute, and (d) theoretical bore and stroke of the compressor. The specific heat of liquid R-12 is 1.235KJ/KgK

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(3)

and of vapour R-12 is 0.733 KJ/KgK. The properties of R-12 are given below---

Saturation Temp. °C	Pressure Bar	Enthalpy, KJ/Kg		Entropy KJ/KgK		Specific Volume m³ /Kg	
		Liquid	Vapour	Liquid	Vapour	Liquid	Vapour
-30	1.0044	8.86	174.20	0.0371	0.7171	0.00673	0.1596
25	6.5184	59.7	197.73	0.2239	0.6868	0.00764	0.0269

Q.IV (a) What are the advantages of compound compression with intercooler over single stage compression ? 6

(b) Classify refrigerant ? 6

Q.V (a) Draw a neat diagram of three fluid system of refrigeration (Electrolux Refrigeration System) and explain its working. 6

(b) Compare the refrigerants R-11, R-12 and R-134a in regard to the following—

- Normal boiling point
- Range of refrigeration temperatures, for which used
- Types of compressor used and their special features.

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(iv) Maximum capacity of plants using these refrigerants

(v) Types of heating, refrigerating and air-conditioning application.

Q.VI (a) Draw a neat sketch and explain thermostatic expansion valve. 6

(b) Sketch and explain a cascade refrigeration system. Draw cascade refrigeration cycle on temperature- entropy and pressure-enthalpy diagrams. 6

Q.VII (a) Draw the temperature-entropy and enthalpy-entropy diagrams of a steam jet refrigeration system. What is the principle of a steam jet refrigeration system. 6

(b) 800m³/min of recirculated air at 22°C DBT and 10°C dew point temperature is to be mixed with 300m³/min of fresh air at 30°C DBT and 50% RH. Determine the enthalpy, specific volume, humidity ratio and dew point temperature of the mixture. 6

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Q.VIII. Solve any one of the following—

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- (a) Following data refers to an air conditioning system to be designed for an industrial process for hot and wet climate : Outside conditions = 30°C DBT & 75% RH required inside condition = 20°C DBT and 60% RH. The required condition is to be achieved first by cooling and dehumidifying and then by heating. If 20m^3 of air is absorbed by the plant every minute; Find—
- Capacity of the cooling coil in tonnes of refrigeration
 - Capacity of the heating coil in KW; and
 - Amount of water removed per hour.
- (b) Air at 10°C DBT and 90%RH is to be brought to 35°C DBT and 22.5°C WBT with the help of winter air conditioner. If the humidified air comes out of the humidifier at 90%RH, draw the various processes involved on a skeleton psychrometric chart and find—
- The temperature to which the air should be pre-heated, and
 - The efficiency of the air washer.

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- (c) An air conditioned auditorium is to be maintained at 27°C dry bulb temperature and 60% relative humidity. The ambient condition is 40°C dry bulb temperature and 30°C wet bulb temperature. The total sensible heat load is $100,000\text{KJ/h}$ and the total latent heat load is $40,000\text{KJ/h}$. 60% of the return air is re-circulated and mixed with 40% of make up air after the cooling coil. The condition of air leaving the cooling coil is at 18°C .

Determine—

- Room sensible heat factor
- The condition of air entering the auditorium
- The amount of make-up air
- Apparatus dew point; and
- By-pass factor of the cooling coil.

Show the processes on the psychrometric chart.

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