BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH **SEMESTER: VII**
BRANCH: MECHANICAL **SESSION: MO 24**

SUBJECT: ME401 REFRIGERATION AND AIR CONDITIONING

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**

			CO	BL
Q.1(a)	With neat sketch, explain the construction of Bootstrap air- refrigeration system. Also show the various processes in T-s diagram.	[5]	1	3
Q.1(b)	An aircraft refrigeration plant has to handle a cabin load of 25 tonnes. The atmospheric temperature is 16°C. The atmospheric air is compressed to a pressure 0.96 bar and temperature of 29°C due to ram action. This is then further compressed in a compressor to 4.8 bar, cooled in a heat exchanger to 66 °C, expanded in a turbine to 1 bar pressure and supplied to the cabin. The air leaves the cabin at a temperature of 26°C. The isentropic efficiencies of both compressor and turbine are 0.9. Calculate: (i) Mass of air circulated per minute (ii) COP take $\gamma = 1.4$ and $c_p = 1.005 \frac{kJ}{kg}$.	[5]	1	4
Q.2(a)	Discuss the effect of operating conditions on performance of SSS-VCRS with the help of p-h diagram.	[5]	2	3
Q.2(b)	Simple saturated vapour compression refrigeration system using NH_3 has a capacity of 25 TR. Evaporator and condenser temperature are -5℃ and 40 ℃ respectively. Calculate: (a) Mass flow rate of refrigerant (b) COP Take c_{pv} = 2.1897 kJ/kgK. Properties are given below:	[5]	2	2

Saturation temperature, ℃	h_f, kJ/kg	h_g, kJ/kg	s_f, kJ/kgk	s
-5	176.9	1456.1	0.9154	5
40	390.6	1490.4	1.6437	5

Q.3(a)	Show that, the $COP_{ideal\,VARS} = COP_{Carnot} \times \eta_{Carnot}$. Also, list the advantages of VARS over VCRS.	[5]	3	3
Q.3(b)	With suitable sketch, explain the construction and working of Electrolux refrigerator.	[5]	3	2
Q.4(a)	0.006 kg of water vapour per kg of atmospheric air is removed and temperature of air after removing the water vapour becomes 22℃. Determine using psychrometry relations: i. Relative humidity, ii. Dew point temperature. Assume that the condition of atmospheric air is 35℃, relative humidity is 60% and pressure is 1.0132 bar.	[5]	4	4

PTO

Q.4(b)	Air at 35°C DBT and 22°C WBT is passed through a cooling coil. The apparatus dew point of the cooling coil is 4°C. The heat extracted by the cooling coil from air is 12 kW and the air flow rate is 45 m^3/min. Determine using psychrometry charts: i. Relative humidity of the air passing through the coil, ii. DBT, WBT and relative humidity of the air leaving the coil, Coil by-pass factor.	[5]	4	4
Q.5(a)	What is freeze drying. Discuss the equipment's used in freeze drying process.	[5]	5	3
Q.5(b)	With a neat sketch, explain the construction and working of Ice plant.	[5]	5	4

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