BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION MO/23

CLASS: BTECH **SEMESTER: VII**
BRANCH: MECHANICAL **SESSION: MO/23**

SUBJECT: ME401 REFRIGERATION AND AIRCONDITIONING

TIME: 03 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. **Steam Tables and Psychrometry chart will be supplied to the candidates.**

Q.1(a) Explain the construction and working of Bootstrap refrigeration system. Also show the various processes in T-s diagram. [5] CO1 L3

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 of 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: [5] CO1 L3
(i) Mass of air circulated per minute,
(ii) COP
take γ=1.4 and c_p=1.005 kJ/kg.

Q.2(a) Discuss the effect of superheating and subcooling on the performance of vapour compression refrigeration system with the support of p-h and T-s diagram. [5] CO2 L2

Q.2(b) An ammonia refrigerator produces 15 Tonnes of ice from and at 0°C in a day of 24 hrs. The temperature range of working cycle is 25°C. The ammonia vapour is dry and saturated at the end of compression. Assume actual COP is 55% of theoretical. Calculate the power required to drive the compressor and mass flow rate in kg/min. [5] CO2 L3
Take $c_{p,water}$ = 4.2 kJ/kgK and latent heat of ice = 335 kJ/kg.
Properties of ammonia are given below:

Saturation temperature, °C	Specific Enthalpy (kJ/kg)		Specific Entropy (kJ/kgK)	
	Liquid	Vapour	Liquid	Vapour
25	380.74	1319.21	0.3473	4.4894
-15	-54.56	1304.99	-0.2134	5.0585

Q.3(a) Argue why vapour absorption system is better than vapour compression system. [5] CO3 L5

Q.3(b) With suitable sketch, explain the construction and working of Electrolux refrigerator. [5] CO3 L3

Q.4(a) The pressure and temperature of mixture of dry air and water vapour are 736 mm of Hg and 21℃. The dew point temperature of the mixture is 15℃, find the followings (using psychrometry relations): [5] CO4 L3

i. Partial pressure of water vapour in the mixture.
ii. Relative humidity
iii. Specific humidity
iv. Enthaply of mixture per kg of dry air.

Q.4(b) 400 m^3/min of recirculated air at 20℃ DBT and 10℃ DPT is mixed with 150 m^3/min of fresh air at 35℃DBT and 45% RH. Determine (using psychrometric chart): [5] CO4 L3

i. Enthaply
ii. Specific volume
iii. Humidity ratio
iv. Dew point temperature of the mixture.

Q.5(a) Explain Freeze drying and what are the steps required to Freeze drying a product. [5] CO5 L1

Q.5(b) With neat sketch, explain the construction and working of Domestic refrigerator. [5] CO5 L3

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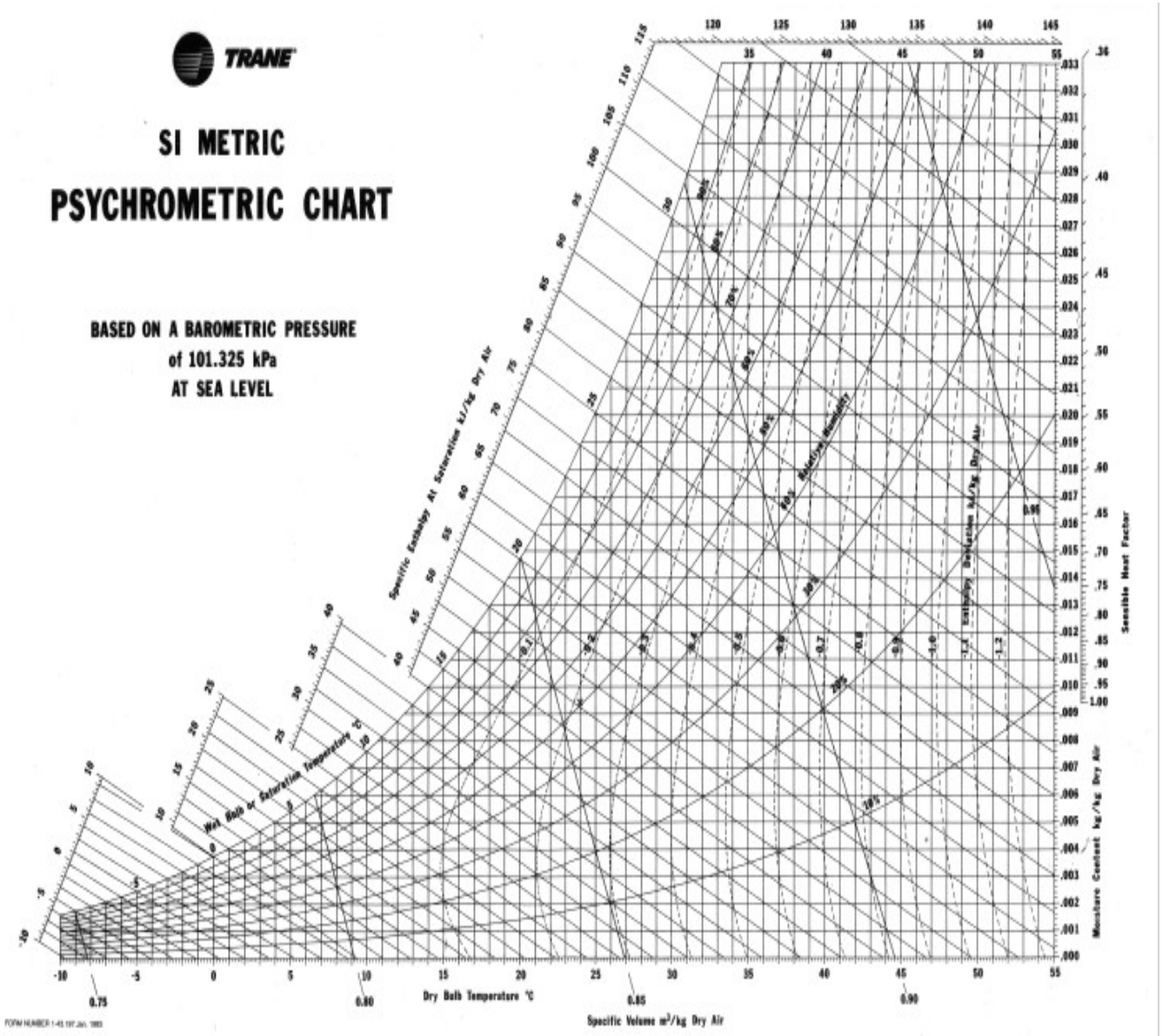
TRANE

SI METRIC

PSYCHROMETRIC CHART

BASED ON A BAROMETRIC PRESSURE
of 101.325 kPa
AT SEA LEVEL



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