

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

**CLASS: BTECH  
BRANCH: MECHANICAL**

**SEMESTER : VII  
SESSION : MO/2022**

**SUBJECT: ME401 REFRIGERATION AND AIRCONDITIONING**

**TIME: 3:00 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.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

- Q.1(a) With neat sketch, explain the construction and working of simple air- refrigeration system with evaporative cooling. Also show the various processes in T-s diagram. [5] CO1 L3
- Q.1(b) A dense air refrigeration cycle operates between 5 bar and 20 bar. The air temperature after heat rejection to surroundings is 37°C and air temperature at exit of refrigerator is 7°C. The isentropic efficiency of compressor and turbine are 0.84 and 0.82 respectively. Determine:  
 i. Compressor and turbine work per tonne of refrigeration.  
 ii. Co-efficient of performance,  
 iii. Power per tonne of refrigeration.  
 take  $\gamma=1.4$  and  $c_p=1.005$  kJ/kg.

- Q.2(a) Discuss the effect of operating conditions on performance of SSS-VCRS. [5] CO2 L2
- Q.2(b) A 5 Tons Freon-12 refrigeration plant has saturated suction temperature of -5°C. The condensation takes place at 32°C and there is no undercooling of refrigerant liquid. Assuming isentropic compression, find:  
 (a) Mass flow rate of refrigerant,  
 (b) Power required to run the compressor in kW.  
 (c) COP

Take  $c_{pv} = 0.615$  kJ/kgK.

Properties are given below:

Saturation temperature, °C	P (bar)	$h_f$ , kJ/kg	$h_g$ , kJ/kg	$s_g$ , kJ/kg
-5	2.61	-	249.3	1.557
40	7.85	130.5	264.5	1.557

- Q.3(a) Prove that the Ideal COP of vapour absorption system is the product of efficiency of Carnot heat engine and COP of Carnot refrigeration system. Also, list the advantages of VARS over VCRS. [5] CO3 L5
- Q.3(b) With suitable sketch, explain the construction and working of Lithium Bromide- Water (LiBr-H<sub>2</sub>O) vapour absorption system. [5] CO3 L3
- Q.4(a) 0.004 kg of water vapour per kg of atmospheric air is removed and temperature of air after removing the water vapour becomes 20°C. Determine:  
 i. Relative humidity,  
 ii. Dew point temperature.  
 Assume that the condition of atmospheric air is 30°C, relative humidity is 55% and pressure is 1.0132 bar.
- Q.4(b) Air at 35°C DBT and 20°C WBT is passed through a cooling coil. The apparatus dew point of the cooling coil is 5°C. The heat extracted by the cooling coil from air is 10 kW and the air flow rate is 40 m<sup>3</sup>/min. Determine:  
 i. Relative humidity of the air passing through the coil,  
 ii. DBT, WBT and relative humidity of the air leaving the coil,  
 iii. Coil by-pass factor.

- Q.5(a) What is IQF technique. List its advantages. [5] CO5 L1
- Q.5(b) With neat sketch, explain the construction and working of Ice plant. [5] CO5 L3

**PTO**

# Metric Psychrometric Chart

