

**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**  
**End Semester Examination, April/May 2018**

**Course : THERMAL UTILITIES - II**  
**Program: M.TECH (ES)**  
**Time: 03 hrs.**

**Semester: II**  
**Max. Marks: 100**

**Instructions: STEAM TABLE AND PSYCHROMETRIC CHART ALLOWED**

**SECTION A**

S. No.		Marks	CO
	<b>Attempt all the questions</b>	<b>20</b>	<b>CO1</b>
Q 1	Distinguish between dry and wet compression .What are the advantages of one over the other.	<b>4</b>	<b>CO1</b>
Q 2	Explain the effect of low suction pressure and high delivery pressure on volumetric efficiency of a reciprocating compressor.	<b>4</b>	<b>CO5</b>
Q 3	Discuss briefly the factors affecting the choice of refrigerant commonly used in refrigerating plants.	<b>4</b>	<b>CO1</b>
Q 4	Define the term bypass factor used for cooling coil and heating coil. And find the expression for that.	<b>4</b>	<b>CO2</b>
Q 5	Explain why entropy remains constant for a reversible adiabatic process	<b>4</b>	<b>CO1</b>

**SECTION B**

	<b>Attempt any four of the following :</b>	<b>40</b>	
Q 6	A single cylinder reciprocating compressor has a bore of 120 mm and a stroke of 150 mm, and is driven at a speed of 1200 rpm. It is compressing CO <sub>2</sub> gas from a pressure of 120 kPa and a temperature of 20°C to a temperature of 215°C .Assuming polytropic compression with n=1.3 ,no clearance and volumetric efficiency of 100%. Calculate (a) pressure ratio (b) indicated power (c) shaft power with a mechanical efficiency of 80%. (d) Mass flow rate.	<b>10</b>	<b>CO5</b>
Q 7	Discuss the working of lithium bromide vapour absorption refrigeration system.	<b>10</b>	<b>CO3</b>
Q 8	In an absorption type refrigerator ,the heat is supplied to ammonia generator by condensing steam at 2 bar and 90% dry .The temperature to be maintained in the refrigerator at -5°C.The temperature of the atmosphere is 30 °C .Find the maximum COP possible of the refrigerator .If the refrigeration load is 20 tons and actual COP is 70 % of the maximum COP ,find the mass of steam required per hour.	<b>10</b>	<b>CO3</b>
Q 9	Discuss the working of centrifugal pump and elaborate its advantages over reciprocating pump.	<b>10</b>	<b>CO4</b>
Q 10	A reversible engine operates between temperatures T <sub>1</sub> and T (T <sub>1</sub> > T). The energy rejected from this engine is received by a second reversible engine at the same temperature T. The second engine rejects energy at temperature T <sub>2</sub> (T <sub>2</sub> < T) that temperature T is the arithmetic mean of temperatures T <sub>1</sub> and T <sub>2</sub> if the	<b>10</b>	<b>CO6</b>

engines produce the same amount of work output.

**SECTION-C**

**Attempt all the questions**

Q 11 An ammonia refrigerator produces 15 tons of ice from and at 0°C in a day 24 hours .The temperature range of the working cycle is 25°C and -15°C. The ammonia vapour is dry saturated at the end of the compression . Assume the actual C.O.P is 55% of the theoretical . Calculate the power required to drive the compressor and mass flow rate in kg/min .

Take the latent heat of ice = 335 kJ/kg and Cp = (water) 4.2 kJ/kg°C.

Use the following properties of NH<sub>3</sub>.

Temp °C	Specific enthalpy (kJ/Kg)		Specific entropy (kJ/Kg-k)	
	Liquid h <sub>f</sub>	Saturated vapour h <sub>g</sub>	Liquid s <sub>f</sub>	Saturated vapour s <sub>g</sub>
25	380.74	1319.21	0.3473	4.4894
-15	-54.56	1304.99	-0.2134	5.0585

**10 CO2**

Q 12 A Carnot refrigeration system using R<sub>12</sub> as a working fluid operates between 35 °C and -30°C. Determine the work of compression ,refrigeration effect and COP of the cycle .If the actual COP is 45% of the Carnot COP ,when working between the same temperature ,calculate the power consumption and heat rejected per ton of refrigeration .

OR

The atmospheric air at 30°C dry bulb temperature and 75% relative humidity enters a cooling coil at the rate of 200 m<sup>3</sup>/min . The coil dew point temperature is 14 °C and the bypass factor of the coil is 0.1 . Determine 1. The temperature of air leaving the cooling coil. 2. The capacity of cooling coil 3. The amount of water vapour removed per minute 4. The sensible heat factor of the process

**10 CO6,CO2**

Q 13 An air conditioning system is to be maintained at 27°C DBT and 60% Relative humidity. The ambient conditions are 40°C DBT and 30°C WBT .The total

**20 CO2**

sensible heat load is 1000000 kJ/h and the total latent heat load is 45000kJ/h .60% of the return air is recirculated and mixed with 40% of fresh air before the cooling coil. The condition of the air leaving the cooling coil is 18°C.

**Determine:**

- a) Room sensible heat factor
- b) The condition of air entering the auditorium
- c) Amount of make up air.
- d) Apparatus dew point temperature
- e) Bypass factor of the cooling coil

Show the processes on psychrometric chart.