UPES

University of Petroleum & Energy Studies, Dehradun

Examination   : End Semester Examination May 2018
Program Name   : B. Tech Chemical (Spl. Refining & Petrochemicals)
Semester   : VI
Subject Name   : Plant Utilities
Duration   : 3 hrs.
Subject Code   : CHEG 454
Max. Marks   : 100
Pages   : 2

Instructions:
1. **Put your Roll No. immediately on the question paper. Do not put any other comments .**
2. **Answer all parts of a question at one place only. Mark question number and part number clearly in the left margin.**
3. **The question paper is self-sufficient and self-evident and needs no extra data and clarification. But in case you need, assume data, and justify your assumptions.**
4. **No student is allowed to leave exam hall in the first hour of exam.**
5. **Use of unfair means will lead to immediate disqualification.**

Section A: 6 Q x 10 m = 60 Marks [Answer ALL]

Q1. Explain the principles of use of steam. What are the ways for steam pipeline design?   **[CO2][10]**

Q2. What are the desirable properties of steam trap. Explain the construction, working, merits and demerits of any one steam trap in detail.   **[CO2][10]**

Q3. Give a detailed classification of Air Compressor Machines**.** Prepare a comparison chart of reciprocating, Lobe type rotary and centrifugal compressor in terms of pressures developed, capacities, advantages and disadvantages.   **[CO1] [10]**

Q4. Describe a two stage refrigeration cycle with thermodynamic chart and also describe the important equipment used in this cycle. What are the advantages and disadvantages of this cycle.   **[CO3][10]**

Q5. Describe various psychrometric processes for example humidification, dehumidification, sensible cooling etc. on a simplified psychrometric chart prepared by yourself on a DBT-Absolute humidity scale with DBT on x axis and absolute humidity on y-axis. What is the problem of moisture in utility air and how is this problem tackled.   **[CO1] [10]**

Q6. What is meant by flaring. Describe the flaring operations and associated safety measures in detail. Why in some situations, we have to use rupture disks.   **[CO4] [10]**

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Section B: 2 Q x 20 m = 40 Marks [Answer ALL]

Q7. (a) Write down the expression of volumetric efficiency. On what factors is dependence of volumetric efficiency? How is volumetric efficiency different from mechanical efficiency. **[CO2][5]**

(b) For a 2-stage compression with imperfect interstage cooling ($T_1 \neq T_3$) following data is given. **[CO2] [15]**
FAD = 145 m^3/hr
P_1= 1 bar
P_3 = 17.5 bar
T_1 = 34 °C
T_3 = 40 °C
Bore of LP compressor = 2 * Bore of HP compressor
Index of Compression = 1.22
Take free air pressure = 1.01325 bar, G = 0.287 kJ/kg-°C, and ambient temperature = 15 °C.
Find out (i) P_2 (intercooler pressure) (ii) power required (iii) Ratio of bores for minimum work
You may assume same stroke length for both the compressors.

Q8. An ammonia based vapor compression cycle is working between temperatures of 60 °C and -12 °C. Saturation data is given for 30 °C and -12 °C . The plant is supposed to manufacture ice at a temperature of -6 °C from water at 20 °C at the rate of 1500 kg/hr. The actual CoP is ¾ of theoretical CoP. Draw the cycle on T-S coordinates, and explain the working of the cycle. Calculate the wattage of the compressor. Assume specific heat of ice = 2.1 kJ/kg-°C and specific heat of ammonia vapor as 2.93 kJ/kg-°C. **[CO3] [20]**

Pressure, bar	Sat. Temp, °C	Enthalpy, kJ/kg		Entropy, kJ/kg-°C	
		Liquid, h_f	Vapour, h_g	Liquid, s_f	Vapour, s_g
11.67	30	322.9	1467.9	1.2028	4.9805
2.68	-12	126.0	1429.0	0.5093	5.5015