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Name of Examination : **Winter 2020** - (Preview)

Course Code & Course Name : **ME401 - Refrigeration and Air Conditioning**

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Maximum Marks : **60**

Duration : **3 Hrs**

[Edit](#) [Print](#) [View Answer Key](#) [Close](#) **Answer Key Submission Type:** Marking scheme with model answers and solutions of numerical

Instructions:

1. All questions are compulsory.
2. Illustrate your answer with suitable figures/sketches wherever necessary.
3. Assume suitable additional data; if required.
4. Use of logarithmic table, drawing instruments and non programmable calculators is allowed.
5. Figures to the right indicate full marks.

1) Attempt any two sub-questions

- a) The capacity of refrigerator is 450 TR when working between -15°C and 30°C . Find mass of ice produced at 0°C within 24 hours when water is supplied at 20°C . Also find the minimum power required and heat rejected in condenser in kW. Assume the machine to be working on Reversed Carnot cycle. Take C_p for water = 4.18 kJ/kg-K and latent heat of ice as 335 kJ/kg . [06]
- b) Explain in brief any six applications of refrigeration and air conditioning [06]
- c) A Bell-Coleman refrigerator works between pressure limits of 4 bar and 1 bar. After compression, the cooling water reduces the air temperature to 17°C . What is the lowest temperature produced by the ideal machine? Compare the CoP of this machine with that of ideal Carnot cycle machine working between same pressure limits, the temperature at the beginning of compression being -13°C [06]

2) Attempt any two sub-questions

- a) State minimum twelve desirable properties of refrigerant (Ideal refrigerant) [06]
- b) A refrigerating machine of 1 TR capacity working on R-12 as refrigerant has working temperatures of 40°C and -15°C and it uses dry compression . Sketch the process schematically on hand drawn p-h chart and find: [06]
 1. Mass flow rate of refrigerant in kg/s
 2. Compressor work
 3. CoP of system

Take 1 TR= 3.5 kW, Use the P-h chart provided for reading the required properties

- c) A VCR uses R-12 as refrigerant. The temperature in the evaporator is -15°C . The temperature of refrigerant leaving the compressor is 15°C where as the vapour is condensed at 10°C . Represent the cycle on T-s diagram and find the CoP if [06]
 1. there is no undercooling
 2. there is undercooling by 5°C before expansion by throttling.

(Take C_p of superheated vapour as 0.64 kJ/kg-k and that of liquid as 0.94 kJ/kg-K)

The properties of refrigerant are as follows:

Temperature in $^{\circ}\text{C}$	Enthalpy in kJ/kg		Enthalpy in kJ/kg-K	
	Liquid	vapour	Liquid	vapour
-15	22.3	180.88	0.0904	0.7051
10	45.4	191.76	0.1750	0.6921

3) Attempt any two sub-questions

- a) Why is cascaded refrigeration system needed? Explain its working with the help of neat sketch and representation on P-h diagram. Write the expression for it's CoP. [06]
- b) With the help of neat sketch explain the working of Li-Br absorption refrigeration system. State it's advantages and limitations. [06]
- c) Derive the expression for ideal CoP of vapour absorption refrigeration system and hence or otherwise solve the following numerical based on it [06]
In an absorption system heating, cooling and refrigeration takes place at 150°C , 30°C and -20°C respectively. Find theoretical CoP of the system.

4) Attempt all sub-questions

- a) Define [06]
 - i) ADP ii) BPF iii) SHF iv) RSHF v) GSHF and iv) ESHF
- b) The humidity ratio of atmospheric air at 28°C DBT and 760 mm of Hg pressure is 0.016 kg/kg of dry air. Determine [06]
 1. Partial pressure of water vapour
 2. Relative humidity
 3. Dew point temperature
 4. Specific enthalpy

5) Attempt all sub-questions

- a) With the help of neat sketches, describe any three expansion devices used in refrigeration and air conditioning systems [06]
- b) What are the various methods of duct design. Explain in brief these three methods. [06]

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