Code No: I2106/R16

M. Tech. I Semester Regular/Supple Examinations, Jan/Feb-2018

REFRIGERATION AND CRYOGENICS

Common to Thermal Engineering (21) and Thermal Sciences and Energy Systems (18)

Time: 3 Hours **Max. Marks: 60**

Answer any FIVE Questions
All Questions Carry Equal Marks

1. a Explain the methods to improve the COP of vapour compression refrigeration cycle. 5M
   b Prove that the overall COP of a cascade system with two circuits is given by 7M

$$COP = \frac{COP_{LT} * COP_{HT}}{1 + COP_{LT} + COP_{HT}}$$

Where COP_{LT} and COP_{HT} are the COPs of low temperature cycle and high temperature cycle respectively?

2. a Explain the working of i) Flash inter-cooling with multiple compression, ii) water inter-cooling with multiple compression employed in vapour compression system. Discuss their relative merits and demerits. 7M
   b A compressor refrigeration system using R12 as refrigerant develops 15 tons of refrigeration. The evaporation and condensation temperatures are -5^0C and 40^0C respectively, Find the following, 5M
   i) The mass flow rate of the refrigerant, ii)Theoretical power and power per ton of refrigeration to run the compressor, iii) Heat rejected to condenser, iv) COP of the cycle, v)Carnot COP.
   Assume R12 entering the compressor is saturated vapour.

3. a Explain the working of Lithium bromide water absorption refrigeration system. 7M
   b With a neat sketch explain the working of pulse tube refrigeration system. Write its applications? 5M

4. a Discuss in detail the desirable properties of ideal refrigerant. 6M
   b Explain Global warming potential and ozone depleting potential of CFC refrigerants. 6M

5. a A cascade refrigeration system using R22 and R13 is required to produce 20 tonnes of refrigeration at -70^0C. Heat is rejected in cascade condenser by R13 at -5^0C to R22 at -15^0C. The condensation in the water cooled condenser is at 40^0C. Assume simple saturation cycles for both the circuits. Determine: i) Pressure ratio and mass flow rate of each cascade, ii) COP of the combined system. 6M
   b Explain with the help of a neat sketch the principle behind liquefication of helium. 6M

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6. Discuss the following low temperature refrigeration applications.
   i) Super conductivity 4M
   ii) Cryobiology 4M
   iii) Space research 4M

7. a Give few names of insulations which are particularly useful for low temperature applications. Discuss their specific properties and applications. 6M
   b Explain the difficulties in storage and handling of cryogenic liquids. 6M

8. Discuss about the following
   i) Thermoelectric refrigeration 4M
   ii) Refrigerant nomenclature 4M
   iii) Necessity of low temperature 4M

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