

Paper ID & Roll No. to be filled in your Answer Book

Roll No.

110580104010

B. TECH. (MECHANICAL ENGINEERING) (SEM.VI)

**UTU (END SEM.) EXAMINATION, 2013-14**

**REFRIGERATION & AIR CONDITIONING**

*Time: 3.00 Hours]*

*[Total Marks: 100*

**Note:** Attempt all questions, the marks assigned to each question is indicated at question itself.

1. Attempt any four (5X4)
- Explain boot strap air refrigeration system with the help of a neat sketch.
  - Why is Reversed Carnot cycle not a practical cycle? Explain the modifications done to Reversed Carnot cycle in the Reversed Brayton cycle.
  - Derive the expression for the COP of Bell-Coleman cycle.
  - Explain the working of simple air evaporative cooling system used for aircrafts.
  - What are the advantages of dense air refrigeration system over an open air refrigeration system.
  - The capacity of a refrigerator is 200TR when working between  $-8^{\circ}\text{C}$  and  $26^{\circ}\text{C}$ . Determine the mass of ice produced per day from water at  $26^{\circ}\text{C}$ . Also find the power required to derive the unit. Assume that the cycle operates on reversed Carnot cycle and latent heat of ice is  $335\text{Kj/Kg}$ .

Q2. Attempt any four

(5X4)

- (a) Explain the construction of T-S and P-h diagrams and state why P-h diagram is more suitable for calculations over T-S diagram.
- (b) Explain working of cascade refrigeration system with the help of neat sketch.
- (c) Describe the actual vapour compression refrigeration cycle on T-S and P-H diagrams.
- (d) Discuss the effects of subcooling and superheating on the performance of standard vapour compression system.
- (e) A Freon 12 vapour compression system operating at a condenser temperature of  $40^{\circ}\text{C}$  and an evaporator temperature of  $-5^{\circ}\text{C}$  develops 15 tons of refrigeration. Determine mass flow rate of refrigerant circulated and actual COP of the cycle.
- (f) Discuss the advantages of multistage refrigeration system.

Q3. Attempt any two

(10X2)

- (a) Explain the differences between an absorption system and a mechanical vapour compression system.
- (b) Explain with neat sketch the working of a water-lithium bromide absorption refrigeration system. What are its limitations?
- (c) In spite of CFCs being suitable for every specific application from the point of view of their thermodynamic and thermo physical properties, these refrigerants are not eco-friendly. Comment on this statement and explain how these refrigerants are being contemplated to be under Montreal and Kyoto protocol.

Q4. Attempt any two

(10X2)

(a) A restaurant with a capacity of 100 persons is to be air-conditioned with the following condition:

Outside condition :  $30^{\circ}\text{C}$  DBT and 70% RH

Desired inside conditions:  $23^{\circ}\text{C}$  DBT and 55% RH

Quantity of air supplied :  $0.5 \text{ m}^3/\text{min}/\text{person}$

The desired conditions are achieved by cooling, dehumidifying and then heating. Determine:

1. Capacity of cooling coil in tons of refrigeration:
  2. Capacity of heating coil:
  3. Amount of water removed by dehumidifier: and
  4. By pass factor of the heating coil if its surface temperature is  $35^{\circ}\text{C}$ .
- (b) The dry bulb temperature and dew point temperature of moist air at standard atmospheric pressure are  $21^{\circ}\text{C}$  and  $15^{\circ}\text{C}$  respectively. Find the humidity ratio, the degree of saturation, the relative humidity, the specific enthalpy and the specific volume using either moist air table or by using perfect gas relations.
- (c) Explain the procedure to draw the SHF and GSHF line on a psychometric chart.

Q5. Attempt any two

(10X2)

- (a) Derive an expression for the equivalent diameter of circular duct corresponding to a rectangular duct of sides  $a$  and  $b$ , for the same pressure loss per unit length, when 1: The quantity of air passing through both the duct is same, and 2: The velocity of air flowing through both the ducts is same.
- (b) Enumerate the advantages and disadvantages of the capillary tube. Also discuss the practical problems encountered in the operation of expansion valves.
- (c) Differentiate between the centrifugal compressor and the reciprocating compressor from the point of view of effect of evaporator temperature and the condenser temperature on their cooling capacity and power requirement.

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