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Seat No.	
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**T.E. (Mechanical) (Semester – II) Examination, 2014**  
**REFRIGERATION AND AIR CONDITIONING**  
**(2008 Course)**

Time : 3 Hours

Max. Marks : 100

- Instructions :**
- 1) Answers to the **two** Sections should be written in **separate books**.
  - 2) Answer **any three** questions from **each** Section.
  - 3) **Neat** diagrams must be drawn **wherever** necessary.
  - 4) Figures to the **right** side indicate **full** marks.
  - 5) Use of calculator is **allowed**.
  - 6) Assume suitable data, if **necessary**.

SECTION – I

1. a) Explain the followings : 10
  - i) Vortex tube refrigeration.
  - ii) Magnetic refrigeration.
- b) A refrigerator operating on Bell Coleman cycle has pressure limits of 0.10 MPa and 0.80 MPa. Air at 9° C is taken from cold chamber for compression in compressor. After compression it is cooled to 29° C before entering expander. If expansion and compression follows the law  $pV^{1.35} = \text{Constant}$ . Calculate
  - i) Heat rejected in cooling chamber.
  - ii) Compressor work done.
  - iii) COP.

Take  $\gamma = 1.4$ ,  $C_p = 1003 \text{ J/KgK}$ .6

OR

2. a) With neat schematic explain reversed Brayton cycle. Derive an expression for COP for an air refrigeration system working on reversed Brayton cycle. 8
- b) Explain how practical VCC deviates from simple saturated VCC. 8
3. a) What is the selection criteria for refrigerant-absorbent pair in vapour absorption system ? Compare vapour compression with vapour absorption system. 8
- b) A vapour compression refrigerator circulates 270 kg/h of ammonia. Condensation and evaporation takes place at 30° C and –15° C respectively. The temperature after isentropic compression is 75° C and there is no subcooling. The specific heat of superheated vapour is 2.82 kJ/kgK. Determine :
  - i) COP.
  - ii) Ice produced in kg/h at evaporator from water at 30° C and ice at –10° C. Take  $h_{fg}$  at 0° C = 336 kJ/kg and  $C_{pw} = 4187 \text{ J/kg}$ .
  - iii) Swept volume of compressor in m<sup>3</sup>/min. 8

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**Ammonia properties :**

T (°C) ↓	P (KPa) ↓	$\rho_i$ (Kg/m³)	$\rho_v$	$h_f$ (KJ/Kg)	$h_g$	$s_f$ (KJ/Kg.K)	$s_g$
30	1167.2	595.1	9.05	484.9	1629.3	1.95	5.73
-15	236.1	658.6	1.96	274.3	1587.5	1.21	6.30

**OR**

4. a) With neat schematic explain the working of double effect vapour absorption refrigeration system. 8
- b) Explain the use of following components in vapour compression system : 8
- i) Accumulator
  - ii) Receiver
  - iii) Filter/dryer
  - iv) Solenoid valve.
5. a) Explain the characteristics and uses of the following refrigerants : 9
- i) R 134a
  - ii) R22
  - iii) Ammonia.
- b) A two stage vapour compression machine delivers 22.5 TR while working between -30° C and 42° C. Determine optimal operating pressure for flash chamber. Draw the schematic for system and cycle on p-h diagram. Using Mollier diagram of R12, determine : 9
- i) COP of system
  - ii) Power required to run the compressor
  - iii) Mass circulation rate in LP and HP compressor
  - iv) Volume handles by LP compressor.

**OR**

6. a) Discuss ODP, GWP and TEWI of refrigerant. 9
- b) Explain compound compression, multiple expansion valve multi-evaporator system. Sketch system schematic and draw cycle of p-h diagram. Perform the system analysis and give the expression for COP of this system. 9

**SECTION – II**

7. a) What are the factors that affect the human comfort ? Discuss their effect in brief. 4
- b) In the summer the outer surface of glass filled with ice water frequently ‘sweats’. How can you explain its mechanism ? 4
- c) Air at 40° C and 60% RH is cooled to 25° C DBT. It is achieved by cooling and dehumidification. Air flow rate is 40 m³/min. Using psychrometric chart, calculate :
- i) Dew point temperature
  - ii) Mass of water drained per hour
  - iii) Capacity of cooling coil and
  - iv) If apparatus dew point temperature is 20° C, find the by-pass factor of coil. 10

**OR**



8. a) Define (i) dew point temperature and (ii) relative humidity with their notations and units. **4**  
 b) Prove that the specific humidity is given by **6**

$$\omega = 0.622 \frac{p_v}{p - p_v}$$

where  $p$  = total pressure of air, and

$p_v$  = partial pressure of moisture in air.

- c) Air enters a window air-conditioner at 1 atm and  $30^\circ\text{C}$  and 80% RH at a rate of  $10\text{ m}^3/\text{min}$  and leaves as saturated at  $14^\circ\text{C}$ . A part of moisture which condenses during the process is also removed at  $14^\circ\text{C}$ . Determine the heat flow rate and moisture removed from the air.

Show the process on psychrometric diagram. **8**

9. a) Compare unitary and central air conditioning systems. **6**  
 b) State different methods of air cleaning for air conditioning space. Discuss any two of them. **6**  
 c) What is coil selection criterion in an air conditioning system ? Explain. **4**

OR

10. a) Explain operating principle, construction and working of an air handling unit with a neat sketch. **7**  
 b) What do you mean by infiltration and ventilation load ? **4**  
 c) Explain the working of flooded evaporator with a neat sketch. **5**

11. a) What are desirable properties of duct materials ? **4**  
 b) What are the velocity reduction methods ? Discuss any one of them. **4**  
 c) A rectangular duct section  $500\text{ mm} \times 350\text{ mm}$  carries  $1.25\text{ m}^3/\text{sec}$  of air having density of  $1.15\text{ kg/m}^3$ . Calculate the equivalent diameter of circular duct for **8**  
 i) Same quantity of air handling in both cases  
 ii) Same velocity of air in both cases  
 iii) If  $f = 0.001$  for sheet metal, find the paper drop per  $100\text{ m}$  length of duct.

OR

12. a) What are dynamic losses in duct ? State. **4**  
 b) Prove that for a rectangular duct of side  $a$  and  $b$ , the hydraulic diameter for same flow rate is given by **6**

$$D = 1.265 \left( \frac{a^3 b^3}{a + b} \right)^{1/5}$$

- c) Discuss the various methods of food preservation. **6**

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