

Total No. of Questions : 10]

P3267

SEAT No. :

[Total No. of Pages : 4

[5670]-536

B.E. (Mech.)

**HEATING, VENTILATION, AIR - CONDITIONING
AND REFRIGERATION**

(Semester - I) (2015 Pattern) (Elective - I) (402044C)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Attempt Q. 1 or Q. 2 Q. 3 or Q. 4 Q. 5 or Q. 6., Q. 7 or Q. 8, Q. 9 or Q. 10.
- 2) Assume suitable data whenever necessary.
- 3) Use of non-programmable pocket calculator is allowed.
- 4) Draw neat diagram whenever necessary.
- 5) Figure to the right indicate full marks.

Q1) a) What is trans-critical cycle? State Advantages and disadvantages of trans-critical cycle. **[4]**

- b) 28 tons of ice from and at 0 °C is produced per day in an ammonia refrigerator. The temperature range in the compressor is from 25 °C to -15°C. The vapor is dry and saturated at the end of compression and an expansion valve is used. There is no liquid sub cooling. Assuming actual C.O.P. of 62% of the theoretical, calculate the power required to drive the compressor. Following properties of Ammonia given- **[6]**

Temperature °C	Enthalpy (kJ/kg)		Entropy (kJ/kg.K)	
	Liquid	Vapor	Liquid	Vapor
2.5	298.9	1465.84	1.1242	5.0394
-15	112.34	1426.54	0.4572	5.5490

Take latent heat of ice is 335 kJ/kg

OR

Q2) a) Explain the working with diagram of Internal heat exchange trans-critical Cycle. **[4]**

- b) 1 m³ of gas is compressed adiabatically ($n=1.4$) from 1 bar to 5 bar in a reciprocating compressor with 8% clearance. If the exponent of the re-expansion curve is 1.1 instead of 1.4 Find the percentage increase in the work of compression. **[6]**

P.T.O.

- Q3) a)** Explain Thermostatic expansion valve with diaphragm [3]
- b)** A R_{12} two cylinders reciprocating compressor is designed for 7.5 tons refrigeration capacity at 5 °C evaporating and 40 °C condensing temperatures. The clearance is 5% of stroke and piston speed is limited to 3 m/s. Take $L/D = 0.8$ and compression follows the law of $PV^{1.15} = \text{Constant}$. Pressure drops at suction and discharge values take as 0.2 bar and 0.4 bar respectively. Determine the followings- [7]
- Power required to run the compressor and C.O.P. of the cycle.
 - Volumetric Efficiency of the cycle.
 - RPM of the compressor and dimensions of the compressor.

OR

- Q4) a)** Explain in detail the capacity controls in reciprocating compressor. [6]
- b)** Explain the evaporative condenser with neat diagram. [4]
- Q5) a)** What is a metabolism? Which are the factors affecting Thermal Comfort? [8]
- b)** Explain wind and stack effect with diagram. [8]

OR

- Q6) a)** A building consists of a 0.5 m x 0.5 m window on the wall facing the wind and an opening of 1.5m x 1.0m on the opposite window. The center-to-center distance between the windows in the vertical direction is 1.5 m. The outdoor temperature is 313 K, while the indoor is maintained at 303 K. Calculate the airflow rate due to the combined effect of wind and stack effects, if the wind blows at a speed of 50 kilometer per hour. [10]
- b)** Write in detail the selection criteria of supply air outlet. [6]
- Q7) a)** Explain in detail the “decrement factor” and “time lag” and at which value are they useful? [6]
- b)** A 25 cm thick wall is exposed to the periodic temperature and incident radiant variation on an hourly basis between 7 am and 6 pm is given in the table. Determine average heat gain of the room per unit area of the wall. The outdoor maximum and minimum temperatures are 40°C and

22°C respectively. The outside and inside design temperatures are 40°C and 25°C respectively. What is maximum heat gain and time of maximum heat gain from the wall? [12]

Density of the material, $\rho = 2400 \text{ kg/m}^3$

Thermal Conductivity, $k = 1.5 \text{ W/mK}$

Outside wall Coeff., $h_o = 23 \text{ W/m}^2\text{K}$

Inside wall Coeff., $h_i = 7 \text{ W/m}^2\text{K}$

Time	7 am	8 am	9 am	10 Am	11 am	12 noon	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm
Wall mass (kg/m ²)	Equivalent Temperature Difference (ΔT_E) °C											
500	3.9	3.3	3.3	3.3	3.3	3.3	3.9	4.4	5.5	6.7	9.4	11.1
600	6.1	5.5	5.0	4.4	4.4	4.4	5.0	5.5	5.5	5.5	6.1	6.7

OR

- Q8)** a) Explain the energy conservation building code. [10]
 b) How do one achieve energy conservation in a restaurant air conditioning in the building? Explain in detail [8]

OR

- Q9)** a) Write a note on Sorbents and Desiccants [8]
 b) Explain with diagram the liquid desiccant dehumidifier with heating and cooling coil. [8]

OR

- Q10)** a) Explain with diagram the solid packed tower with dehumidification [8]
 b) Explain thermal storage air conditioning system [8]

