Total No. of Questions : 12]

SEAT No. :

P748

[Total No. of Pages : 4

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B.E. (Automobile Engineering) (Semester - I)

AUTOMOTIVE REFRIGERATION AND AIR CONDITIONING

(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) ***Answer three questions from Section - I & three questions from Section - II.***
2) ***Answers to the two sections should be written in separate books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Assume suitable data, if necessary.***
6) ***Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator, steam tables and psychrometric chart is allowed .***

SECTION - I

Q1) a) Explain Reversed Brayton cycle. **[4]**

b) Derive an expression for COP of Bell Coleman cycle. **[6]**

c) In a Bell - Coleman cycle, environment temperature is 320K and refrigerant temperature is 120K. The minimum temperature of the cycle is 80K. The pressure in the refrigerator is 1 bar. Find the following : **[8]**

i) Maximum pressure and temperature of the cycle.

ii) Refrigerating effect and heat rejected per kg of air.

iii) Net work required per kg of air.

iv) Compressor and expander swept volume per kg of air.

v) COP of the cycle.

OR

Q2) a) Sketch actual vapor compression cycle on P-V and T-S diagram and explain all processes briefly. **[8]**

b) A dense air refrigeration machine operates on reversed Brayton cycle and used for 10 tonnes refrigeration capacity. The cooler pressure is 4.2 bar and refrigerator pressure is 1.4 bar. The air is cooled in the cooler to a temperature of 50°C and the temperature of air at inlet to the compressor is – 20°C for in ideal cycle, determine following.

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i) COP of the system.
ii) Mass of air circulated per minute.
iii) Theoretical piston displacement of the compressor.
iv) Net power per ton of refrigeration.
Show the cycle on P-V & T-S diagram.
Take C_p = 1.07 kJ/kg-K (for dense air). **[10]**

Q3) a) Explain four important thermodynamic & two important each of physical and chemical requirements of refrigerant. **[8]**

b) Describe any two types of expansion devices used in refrigerating system. **[8]**

OR

Q4) a) Explain : GWP, ODP and TEWI. **[6]**

b) Explain different air conditioning system components. **[6]**

c) Explain the refrigerant charge capacity determination. **[4]**

Q5) a) Describe the different air distribution modes in car with neat sketch. **[8]**

b) Write short note on comfort condition in the car A/C system. **[8]**

OR

Q6) a) Explain any one Automatic temperature control device. **[6]**

b) Explain recycle operation modes and cool-down performance. **[6]**

c) Write short note on : **[4]**
i) Air filter
ii) Blower fans

SECTION - II

Q7) a) Explain following psychrometric properties of air. **[8]**
i) Dry air
ii) Moist air
iii) Dry bulb Temp.
iv) Wet Bulb Temp.
v) Dew point Temp.
vi) Dalton's Law of partial pressure
vii) Specific humidity
viii) Relative humidity

b) The DBT and WBT of atmospheric air are 35°C and 23°C respectively when the barometer reads 750 mm of Hg. Determine **[8]**
i) Relative humidity
ii) Humidity ratio
iii) Dew point temperature
iv) Density and
v) Enthalpy of atmospheric air.
Use the carrier equation as given below.

$$P_v = (P_{us})_{wbt} - \frac{[P_t - (P_{us})_{wbt}][T_{ab} - T_{wb}] \times 1.8}{[2800 - 1.3(1.8T_{ab} + 32)]}$$ pressure in mm of Hg.

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OR

Q8) a) Explain sling psychrometer used for DBT and WBT measurement. **[4]**

b) Explain Cooling and Humidification psychrometric process with diagram. **[4]**

c) 30 m^3/min of a stream of moist air at 15°C DBT and 13°C WBT are mixed with 12 m^3/min of a second stream at 25°C DBT and 18°C WBT. Barometric pressure is one standard atmosphere. Determine the dry bulb and wet bulb temperature of the resulting mixture. **[8]**

Q9) a) Explain different types of heat source which contribute to sensible and latent heat for an automobile car. **[8]**

b) The following data were collected in connection with the design of air conditioning a small theatre. **[10]**

Total seating capacity = 350 persons

Atmospheric conditions = 34°C DBT and 70% R.H.

Comfort condition required = 22°C DBT and 50% R.H.

Sensible heat given per person = 320 kJ/hr.

Latent heat given per person = 100 kJ/hr.

Sensible heat due to solar gain and infiltrated air = 16,00,000 kJ/hr.

Latent heat due to infiltrated air = 80,000 kJ/hr.

Quantity of fresh air supplied = 0.4m^3/person/min.

Desirable temp rise in theatre = 8°C.

Assume the re-circulated air is mixed with the fresh air after leaving conditioner.

Using above data, compute the followings.

i) Percentage of total air recirculated.

ii) Refrigeration capacity of the conditioner coil.

Assume air leaves the conditioner coil with 100% R.H.

OR

Q10)a) Define following with neat sketch **[6]**

i) RSHF

ii) ERSHF

iii) GSHF

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b) The following data were collected to design an air conditioning system for restaurant in city. **[12]**

Outside condition = 34°C DBT and 28°C WBT.

Inside design condition = 24°C DBT and 50% R.H.

Solar heat gain through walls, roof & floor = 16,160 kJ/hr.

Solar heat gain through glass = 15,200 kJ/hr.

Occupant = 13 smoking and 12 non - smoking.

Latent heat gain per person = 360 kJ/hr.

Sensible heat gain per person = 300 kJ/hr.

Internal lighting load = 15 lamps of 100 watts capacity each and 100 fluorescent tubes of 80 watt each.

Sensible heat gain from other sources = 40,000 kJ/hr.

Infiltrated air = $14 m^3$/min.

If 40% fresh air and 60% recirculated air mixed and passed through the conditioner coil then find the followings.

i) Amount of total air in m^3/hr.

ii) Dew point temperature of the coil.

iii) The condition of supply air to the room.

iv) The capacity of the conditioner in tonns of refrigeration.

Assume bypass factor of the coil 0.35.

Q11)a) Explain : **[8]**

i) Initial recycle inspection

ii) Odour removal

b) Explain leak detection test **[8]**

OR

Q12)a) What are the classification of sight glass and briefly explain need of sight glass? **[8]**

b) Write a short note on refrigerant recovery recycle and charging. **[8]**

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