

Total No. of printed pages = 4

ME 181 PE 15

Roll No. of candidate

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BINA CHITRAKARTHI CENTRAL LIBRARY
(BANK & GPS)
A-202, Hall No. 202, 203,
Gulwahalli - 781017

B.Tech. 7th Semester End-Term Examination

Mechanical Engineering

REFRIGERATION

New Regulation (wef 2017 – 18) & New Syllabus (wef 2018 – 19)

Full Marks – 70

Time – Three hours

Answer ALL questions

Use of Refrigerant Table and charts are permitted

The figures in the margin indicate full marks
for the questions.

Answer question No. 1 and any *four* from the rest.

1. Answer the following (MCQ/ Fill in the blanks) : (10 × 1 = 10)
- (i) If the work input is 60 KJ/kg and refrigeration effect produced is 120 KJ/kg of refrigerant flowing and theoretical C.O.P. is 4, the Relative C.O.P. of a refrigeration system will be
- (a) 0.65 (b) 0.79
(c) 0.72 (d) 0.50
- (ii) The $(COP)_R$ of a Carnot refrigerating machine is 7.89. What will be the $(COP)_P$ of heat pump?
- (a) 10.3 (b) 7.89
(c) 8.89 (d) 6.89
- (iii) The COP of a Bell Coleman cycle is
- (a) increases with decrease in pressure ratio
(b) increases with increase in pressure ratio
(c) remains constant with pressure ratio
(d) doesnot depend with pressure ratio

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- (iv) Cooling system used for supersonic aircrafts and rockets is?
- (a) Simple air cooling system
 - (b) Simple evaporative cooling system
 - (c) Boot-strap cooling system
 - (d) Regeneration cooling system
- (v) The azeotropic refrigerant is
- (a) R22
 - (b) R134a
 - (c) R404A
 - (d) R502
- (vi) Which is secondary refrigerant?
- (a) HC
 - (b) H₂O
 - (c) HFC
 - (d) HCFC
- (vii) What is the ODP values for the refrigerant R11?
- (a) 1.05
 - (b) 1.00
 - (c) 0.5
 - (d) 0
- (viii) What is flash gas fraction?
- (a) the mass fraction of liquid in liquid-vapour mixture of refrigerant at inlet to the evaporator
 - (b) the mass fraction of vapour in liquid-vapour mixture of refrigerant at inlet to the evaporator
 - (c) the mass of vapour actually compressed to that of vapour ideally compressed
 - (d) none of the above
- (ix) As the evaporator temperature lowers down, the required compression ratio
- (a) becomes lower for a given condensation temperature
 - (b) becomes higher for a given condensation temperature
 - (c) becomes steady for a given condensation temperature
 - (d) cannot say
- (x) The purpose of analyser-rectifier in aqua-ammonia absorption system?
- (a) to absorb ammonia into the water
 - (b) to remove water vapour out from ammonia after generator
 - (c) to exchange heat between weak solution and strong solution
 - (d) none of the above

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2. (a) State the merits and demerits of an air refrigeration system. (5)
- (b) An aircraft moving with speed of 1000 km/h uses simple gas refrigeration cycle for air conditioning. The ambient pressure and temperature are 0.35 bar and -10°C respectively. The pressure ratio of compressor is 4.5. The heat exchanger effectiveness is 0.95. Isentropic efficiencies of compressor and expander are 0.8 each. The cabin pressure and temperature are 1.06 bar and 25°C

Take $C_p = 1.005\text{kJ/KgK}$; $R = 0.287\text{kJ/kgK}$ and $\gamma = 1.4$ for air.

Calculate:

- (i) Temperatures and pressures at all points of the cycle.
- (ii) Volume flow rate through compressor inlet and expander outlet for 100 TR. (10)

3. (a) A refrigeration machine of 6 tones capacity working on Bell, Coleman cycle has an upper limit pressure of 5.2 bar. The pressure and temperature at the start of the compression are 1 bar and 18°C respectively. The cooled compressed air enters the expander at 41°C . Assuming both expansion and compression to be adiabatic with an index of 1.4.

Calculate:

- (i) Co-efficient of performance.
- (ii) Quantity of air circulated per minute.
- (iii) Piston displacement of compressor and expander
- (iv) Power required to drive the unit
- (v) Bore of compression and expansion cylinder when the unit runs at 240 rpm and is double acting with stroke length = 200 mm. (8)

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- (b) Write short notes on Glide refrigerant. (3)
- (c) Write the chemical formula of the following refrigerant: R124, R22, R245C, R744. (2)
- (d) What is the difference between R134 and R134a? (2)
4. (a) Why turbine or expander is replaced with throttle valve in vapor compression refrigeration system? (3)
- (b) Discuss the effect of the following on the performance of a vapour compression system: (3)
- (i) Effect of superheating after compression
- (ii) Effect of condenser temperature.

- (c) A food storage locker requires a refrigeration capacity of 50 kW. It works between a condenser temperature of 35°C and an evaporator temperature of -10°C. The refrigerant is ammonia. It is sub cooled by 5°C before entering the expansion valve by the dry saturated vapour leaving the evaporator. Use NH₃ property table.

Calculate:

(i) *The power required,*

(ii) *Mass flow rate of refrigerant*

(iii) *The COP of the system* (9)

5. (a) Explain the working principle of Ammonia-Water (NH₃-H₂O) with neat diagram. (8)

- (b) An ideal vapor-compression refrigerant cycle operates at steady state with Refrigerant 134a as the working fluid. Saturated vapor enters the compressor at -10°C, and saturated liquid leaves the condenser at 30°C. The mass flow rate of refrigerant is 5 kg/min. Using Pressure Enthalpy (P-h) chart

Calculate:

(i) *The compressor power, in kW*

(ii) *The refrigerating capacity, in tons.*

(iii) *The coefficient of performance.* (7)

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6. (a) Draw (Pencil sketch) and explain the working principle of steam jet refrigeration system. (7)

- (b) What are the main purposes of compressor lubrication? (2)

- (c) What are purposes of using expansion valve? Explain the working principle of electronic expansion valve. (2+4=6)

7. Write a short note on (3 × 5 = 15)

(a) Pressure Enthalpy (P-h) chart of refrigerant

(b) Dry air rated temperature (DART)

(c) Preservation of food spoilage.