

Code No: 56018

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD**B. Tech III Year II Semester Examinations, December-2014/January-2015****REFRIGERATION AND AIR CONDITIONING****(Mechanical Engineering)****Time: 3 hours****Max. Marks: 75**

Answer any five questions
All questions carry equal marks

- 1.a) Discuss the advantages of dense air refrigerating system over an open air refrigerating system. What is meant by C.O.P of a refrigerating machine?
- b) In a refrigerator working on Bell-coleman cycle, the air is drawn into the cylinder of the compressor from the cold chamber at a pressure of 1.03 bar and temperature 12°C . After isentropic compression to 5.5 bar, the air is cooled at constant pressure to a temperature of 22°C . The polytropic expansion $pV^{1.25} = \text{constant}$ then follows and the air expanded to 1.03 bar is passed to cold chamber. Determine:
- Work done per kg of air flow
 - Refrigerating effect per kg of air flow
 - C.O.P
 - Refrigerating capacity of the plant in tonnes for a mass flow rate of 90 kg/h. For air, Take $\gamma = 1.4$ and $c_p = 1.003 \text{ kJ/kg K}$.
- 2.a) Describe the mechanism of a simple vapor compression refrigeration system.
- b) A water cooler using F_{12} as refrigerant works between 26°C and 2°C respectively. The vapor leaves the evaporator dry and saturated. The output of cold water is 100 kg per hour cooled from 26°C to 6°C . Assuming the following:
- Volumetric efficiency of the compressor = 80%.
Mechanical efficiency of the compressor = 85%.
Mechanical efficiency of the motor = 95%.
Assume 20% of the useful cooling is lost into the water cooler.
Find the followings:
- Power required to run the motor
 - Volumetric displacement of the compressor.
- Take C_p (water) = 4.2 kJ/kg-K.
- 3.a) "A completely odourless refrigerant is not desirable", discuss the statement.
- b) Draw a neat sketch of a hand-operated expansion valve and explain its working.
- 4.a) Derive an expression for C.O.P. of an ideal vapour absorption system in terms of T_G , T_E and T_C .
Where T_G = Temperature at which heat is supplied to generator,
 T_E = Temperature at which heat is absorbed in the evaporator, and
 T_C = Temperature at which heat is discharged from condenser and absorber.
- b) Draw a neat compact diagram of Lithium bromide water absorption refrigeration system and explain its working. List out the major fields of applications of this refrigeration system.

5. The following data refer to a steam jet refrigeration system:
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| Capacity of thermal power plant----- | 2000 kW |
| Condition of steam supplied from the boiler----- | 25 bar, 350°C |
| Refrigeration load taken up by the steam jet refrigeration system----- | 110 tonnes |
| Pressure at which steam is bled off the steam turbine----- | 4 bar |
| Vacuum maintained in the condenser----- | 730 mm of Hg |
| Pressure and condition at which steam enters in thermo-compressor--- | 0.01 bar, 0.92 dry |
| Temperature at which make-up water enters into flash chamber----- | 20°C |
| Isentropic efficiency of the steam turbine ----- | 88% |
| Nozzle efficiency----- | 88% |
| Entrainment efficiency----- | 64% |
| Thermo-compressor efficiency----- | 64% |
- Determine the following, using Mollier diagram:
- Dryness fraction of steam leaving the flash chamber
 - Mass of motive steam bled off from the steam turbine
 - Mass of steam generated in the boiler
 - C.O.P of the system.
- 6.a) Explain how the psychrometric chart is prepared.
- b) The following data relate to summer air-conditioning of a building:
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|---|--------------------|
| Outside design conditions----- | 42°C DBT, 28°C WBT |
| Inside design conditions----- | 24°C DBT, 50% RH |
| Room sensible heat gain----- | 82000kJ/h |
| Room latent heat gain----- | 18000kJ/h |
| By-pass factor of the cooling coil----- | 0.2 |
- The return air from the room is mixed with outside air before entry to cooling coil in the ratio of 4:1 by mass. Determine:
- Apparatus dew point (ADP) of the coil
 - Entry and exit conditions of the air for cooling coil
 - Fresh air mass flow rate
 - Refrigeration load on the cooling coil.
- 7.a) Define the “human comfort” and explain the factors which affect human comfort.
- b) Why ventilation is required? Explain why different ventilation standards for different purposes are recommended.
8. Explain the following:
- Central station air-conditioning system.
 - Different heat pump circuit.