

IV B.Tech I Semester Supplementary Examinations, April/May 2005
REFRIGERATION & AIR CONDITIONING
(Mechanical Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
 All Questions carry equal marks

1. (a) Derive an expression for COP of a Bell-Coleman cycle plotting the same on a P-V diagram.
 (b) A Bell-coleman refrigeration cycle works between 1 bar and 6 bar. The adiabatic efficiency of compression is 90% and expansion is 95%. Find the COP of the system and its tonnage when the air flow rate is 2 kg/sec. The ambient temperature is 25°C and refrigerator temperature is -5°C.
2. (a) Draw the p-h diagram for a simple vapour compression cycle.
 (b) An ammonia vapour compression refrigerator works between temperature limits of -6.7°C and 26.7°C. The vapour is dry at the end of compression and there is no under cooling of the liquid, which is throttled to the lower temperature. Estimate the C.O.P of the machine. Properties of ammonia given below should be used.

Temperature °C	Enthalpy kJ/kg			Entropy kJ/kg	
	Sensible (h_f)	Latent (h_{fg})	Vapour (h)	Liquid (s_r)	Vapour (s_g)
-6.7	-29.3	1293.8	1264.5	-0.113	4.752
26.7	125.6	1172.4	1297.9	0.427	4.334

3. (a) Describe the important components of a centrifugal compressor with the help of a neat sketch.
 (b) Name the two types of rotary compressors. Explain the working of anyone type of rotary compressor.
4. (a) Explain the working of a automatic expansion valve with the help of a neat sketch.
 (b) Describe the working of shell and tube type and shell and coil type evaporators.
5. The following efficiencies must be assumed
 Isentropic efficiency of turbine = 90%
 Steam jet refrigeration nozzle efficiency = 90%
 Entrainment efficiency = 65%
 Thermo compressor efficiency = 65%
 The steam enters the thermo compressor at 0.01 bar and with dryness fraction of 0.94, make up water enters the flash chamber at 18°C
 determine (using Mollier diagram)

- (a) State of steam at all salient points

- (b) Quantity of steam leaving the flash chamber
 - (c) Quality of steam generated in the boiler
 - (d) COP of the steam jet refrigeration system based on the heat input of the motive steam
Assume the same condenser for power turbine and steam jet refrigeration.
6. In a Steam jet refrigeration system dry saturated steam at 7 bar abs. pressure is supplied. The flash chamber temperature is 5°C , the condenser temperature is 40°C , make up water is supplied at 20°C . Assuming that quality of motive steam and flash vapour at the beginning of compression as 93% dry and efficiency of the nozzle, efficiency of expansion and the efficiency of the thermo-compressor as 90%, 65% and 91% respectively. Determine:
- (a) Weight of steam required per hour per ton of refrigeration.
 - (b) The volume of vapour removed from the flash chamber per hour per ton of refrigeration.
7. A spray cooling coil is selected to operate under the following conditions
- | | |
|-------------------------|---|
| Air inlet condition | 28°C DBT and 21°C WBT |
| Air outlet condition | 10°C DBT and 6°C WBT |
| Total amount of airflow | $2000\text{m}^3/\text{min}$ |
- The chilled water inlet and outlet temperatures are 7°C and 12°C respectively. Find the following,
- (a) cooling load on the coil
 - (b) water flow rate through the coil
8. (a) Draw the layout for a central air conditioning system that you would suggest for your institution for cooling in summer.
- (b) Explain the working of a window air conditioner by drawing a neat sketch.
