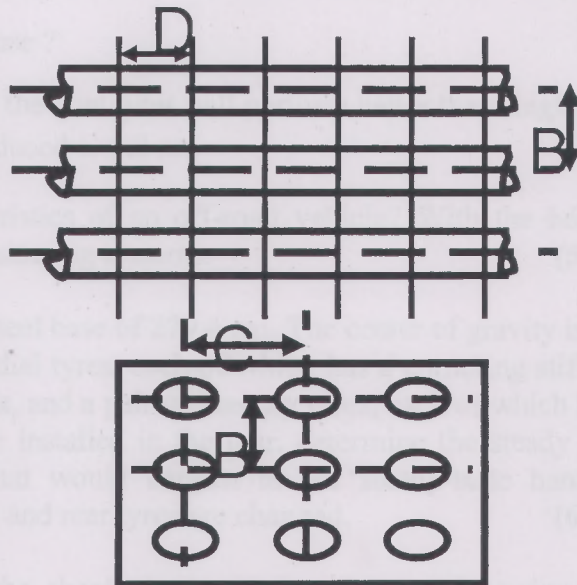


Agricultural & Food Engineering Department, IIT Kharagpur
End Autumn Semester Examination 2011-2012

Degree: M Tech (FPE)
 Subject: AG60123 Cooling Technology
 Number of students: 10+1

Date: 25-11-2011
 Time: 3 Hrs
 Full Marks: 50

- Q1. Discuss with T-s and p-h diagram different aspects of the liquid and vapour regime of a pure substance. [10]
- Q2. Moist air enters an insulated duct at the rate of 20 kg s^{-1} at 20°C with 50% relative humidity and standard atmospheric pressure. It is heated by a heater of 50 kW capacity and steam at the rate of 0.5 kg s^{-1} is injected at 100°C . Find the outlet state, and the sensible and latent heat transfer rates. Do not use steam table or psychrometrics chart. Given, at 20°C , $P_{ws} = 0.02339 \text{ bar}$; $h_g = 2537.4 \text{ kJ kg}^{-1}$; at 100°C , $h_{st} = h_g = 2675.4 \text{ kJ kg}^{-1}$. [10]
- Q3. Draw a schematic diagram of a reciprocating compressor. Discuss about the compressor lubrication. [3+7]
- Q4. Determine the face area for an R12 air condenser for a 10 TR plant with condenser and evaporator temperatures of 30°C and -10°C respectively. The face velocity is 150 m min^{-1} . The inside and out side tube diameters are 11 and 12.5 mm respectively. The inlet air temperature is 30°C . The fin efficiency is 0.75 and the other dimensions of the air cooled condenser with reference to the figure attached are as follows: $B = 40 \text{ mm}$, $C = 35 \text{ mm}$, $D = 3 \text{ mm}$ and $E = 0.3 \text{ mm}$; where B = vertical spacing between the tubes in a row, mm; C = spacing between the tubes in different rows, mm; E = thickness of the fins, mm and D = centre spacing



between the fins, mm; d_o = outer diameter of the tubes, mm; d_i = inner diameter of the tubes, mm [10]

- Q5. Moist air is heated from 30 to 70 °C by hot water whose temperature changes from 90 to 80 °C. Determine the true temperature difference if the heat exchanger is of the following type: (a) pure counterflow, (b) pure parallel flow, (c) average temperature difference, and (d) pure cross flow with one row of tubes. [10]