

Internal Combustion Engines

Applied Thermo-Fluids I - ME41001

Time: 45 minutes

For Air, molecular mass 28.97 kg/kmole; $\gamma = 1.4$; $R = 287 \text{ J/kg.K}$

Acceleration due to gravity 9.81 m/sec^2

An SI engine producing 190.9 N-m brake torque at 3000RPM is having bsfc (brake specific fuel consumption) 240 g/kW-hr. The fuel used is gasoline (C_8H_{18}) and the equivalence ratio is 0.833. Consider the flow to be compressible.

- (a) Calculate the mass flow rate of fuel and air (in kg/sec).
- (b) Derive the necessary equation for air mass flow rate. Calculate the throat diameter of the venturi if the actual air velocity is 120 m/s at the throat. The inlet condition is 101 kPa and 27°C . The discharge coefficient is 0.96 for the venturi.
- (c) Derive the necessary equation for fuel flow rate at the capillary jet. Calculate the diameter of the main metering jet (i.e. capillary fuel nozzle) if the tip of the jet is 2.5 mm above the fuel level in the float chamber. Specific gravity of fuel is 0.77. The discharge coefficient is 0.74 for the capillary nozzle.

$$(2+2)+(4+4)+(4+4)=20$$

Indian Institute of Technology, Kharagpur

Class Test II

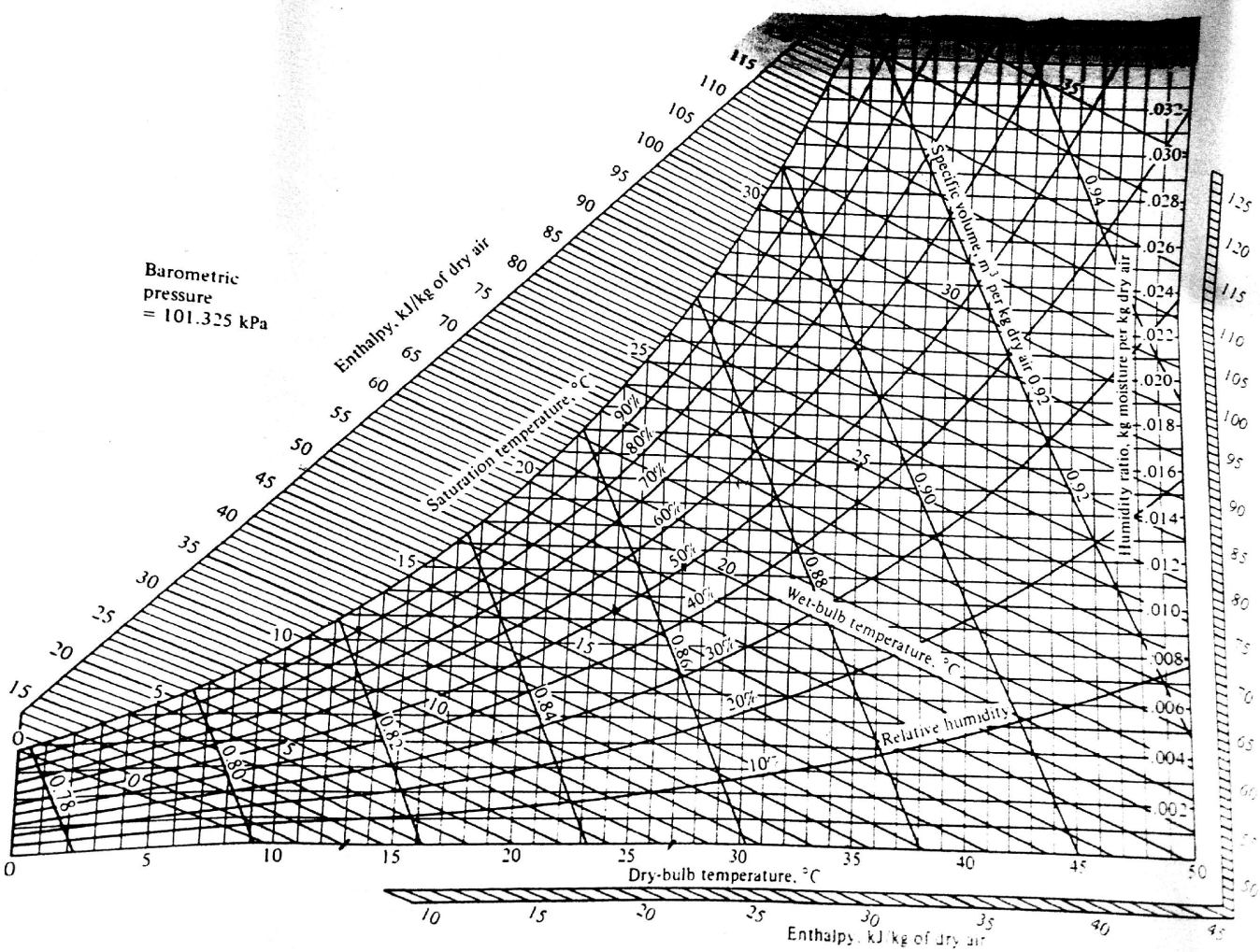
Sub No. ME40701

No. of Students: 130

Full Marks 25

Part-B: Air Conditioning and Refrigeration
of the dept. of **Mech Engg**

- 5 1. Calculate the specific volume of an air-vapour mixture in m^3/kg of dry air when the following conditions prevail: $T=30^\circ\text{C}$, $W=0.015 \text{ kg/kg}$ at standard atmospheric pressure
2. In an air-conditioning unit $3.5 \text{ m}^3/\text{s}$ of air at 27°C dry-bulb temperature, 50% relative humidity, and standard atmospheric pressure enters the unit. The leaving condition of air is 13°C dry-bulb temperature, 90% relative humidity. Using properties from the psychrometric chart
- 5 (a) calculate the refrigerating capacity in kW and
- 5 (b) determine the rate of water transferred from/to the air
3. If an air stream at 24°C dry-bulb temperature, 50% relative humidity mixes with an air stream at 35°C dry-bulb temperature, 25°C wet-bulb temperature in the ratio 4:1, find the following for the mixture
- 5 (a) humidity ratio
- 5 (b) enthalpy in kJ/kg of dry air



Psychrometric Chart
Gas constant of dry air $R_g = 287 \text{ J/kg} \cdot \text{K}$
Gas constant of water vapour $R_{g_v} = 461.5 \text{ J/kg} \cdot \text{K}$

1 - 0.02
0.3 - 2