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Total No. of Questions : 8] *[Total No. of Printed Pages : 3*

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MMTP-102

M.E./M.Tech., I Semester

Examination, June 2016

Thermodynamics and Combustion

Time : Three Hours

Maximum Marks : 70

Note: i) Attempt any five questions. All questions carry equal marks.
ii) Assume missing data suitably, if any.
iii) Draw neat and clean sketches/diagrams/figures wherever required.

1. a) What is Pure substance? Discuss vapor-liquid-solid phase equilibrium giving suitable examples.

   b) A room is heated by an iron that is left plugged in. Is this a heat or work interaction? Take the entire room, including the iron, as the system.

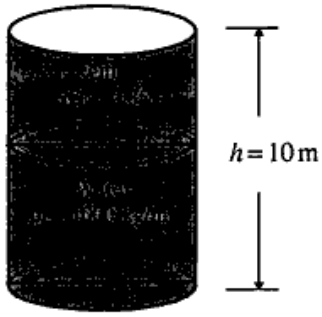
2. a) A can of soft drink at room temperature is put into the refrigerator so that it will cool. Would you model the can of soft drink as a closed system or as an open system? Explain.

   b) During a heating process, the temperature of a system rises by 10°C. Express this rise in temperature in K, °F, and R.

3. a) What do you mean by Equations of state? Compare reaction rates of first, second and higher order reactions.
   b) Determine the atmospheric pressure at a location where the barometric reading is 740mm Hg and the gravitational acceleration is $g = 9.81 m/s^2$. Assume the temperature of mercury to be 10°C, at which its density is $13,570 kg/m^3$.

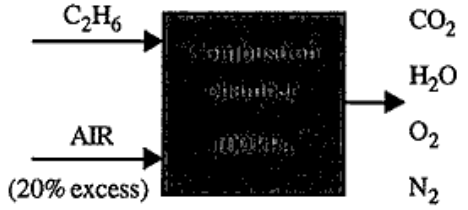
4. a) An office worker claims that a cup of cold coffee on his table warmed up to 80°C by picking up energy from the surrounding air, which is at 25°C. Is there any truth to his claim? Does this process violate any thermodynamic laws?
   b) What is Gibbs phase rule? Discuss law of corresponding states.

5. a) Consider an alcohol and a mercury thermometer that read exactly 0°C at the ice point and 100°C at the steam point. The distance between the two points is divided into 100 equal parts in both thermometers. Do you think these thermometers will give exactly the same reading at a temperature of, say, 60°C? Explain.
   b) The lower half of a 10-m-high cylindrical container is filled with water (Density = 1000 kg/m^3) and the upper half with oil that has a specific gravity of 0.85. Determine the pressure difference between the top and bottom of the cylinder.



6. a) State theory of flame propagation. Compare laminar and turbulent flames.
   b) Compare properties of premixed and diffusion flames.

7. Ethane (C_2H_6) is burned with 20 percent excess air during a combustion process, as shown in figure. Assuming complete combustion and a total pressure of 100kPa, determine:
   i) The air-fuel ratio and
   ii) The dew-point temperature of the products.



8. Write short note on following: (Any two)
   a) Van der wall equations of state
   b) Clapeyron's equation
   c) Combustion of fuel droplets and sprays
   d) Triple point

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