ME (M) THERMAL II (P)

FUEL & COMBUSTION

Con. 3049-09. BB-5766

Page (1)

( 4 Hours) [ Total Marks : 100

**N.B.:** (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.
(3) Assume **suitable data** wherever **required**.
(4) Illustrate answers with sketches wherever **required**.
(5) Use of steam table and combustion table is **permitted**.

1. Answer the following (any **five**) :— 20
   (a) Write a note on the potential of non-renewable energy sources in India.
   (b) Compare ethanol and methanol as a substitute to gasoline fuel.
   (c) What are the advantages and disadvantaes of producer gas if used as a substitute fuel ?
   (d) What do you mean by combustion ? Why is it important even today ?
   (e) How does the adiabatic flame temperature vary with an increase in temperature ? Why is it so ?
   (f) Explain qualitatively how the flame is stabilized in a Bunsen burner.

2. (a) One mole of $CH_4$ is reacted with oxygen in Stoichiometric ratio. Consider that reactants are at 298 K and pressure of 101 KPa. Determine the heat of combustion. 6

   Take $h_f^\circ, CO_2 = -394$ kJ/kmole $h_f^\circ, CH_4 = -74{\cdot}5$ kJ/kmole

   $h_f^\circ, H_2O = -242$ kJ/kmole $h_f^\circ, O_2 = 0$ kJ/kmole

   (b) Why is gaseous fuel being preferred over the solid or liquid fuel in recent times ? What are problems posed by the use of gaseous fuel ? 6
   (c) What do you mean by adiabatic flame temperature ? How can it be estimated ? 4
   (d) What do you understand by homogenous reaction ? How does it differ from heterogenous reaction ? 4

3. (a) Discuss the effects of CO, HC, $NO_x$ and smoke emission on human and biological life. 6
   (b) What are the major effects of Green-House effect on the earth atmosphere ? Suggest the methods to carry out the same. 6
   (c) Draw a line diagram of petroleum refining process and discuss about the products coming out. 4
   (d) Discuss the basic requirements of diesel fuel. 4

4. (a) In order to determine the laminar burning velocity $S_L$ of Stoichiometric Methane-air mixture a conical flame of flame height of 5·1 cm is established using a Bunsen burner with port diameter of 10 mm. If it consumes 10 LPM of fuel-air mixture, determine its burning velocity by area method. 6
   (b) What do you mean by diffusion flame ? How is it different from premixed flame ? 4
   (c) What is the mechanism of soot formation in a diffusion flame ? 4
   (d) How does ozone level influenced by emission from combustion sources ? 4
   (e) What is the most suitable fuel for rocket engine : 2
   (i) gas (ii) liquid or (iii) solid ? Support your choice with some reasons.

[TURN OVER

M.E(M) Thermal II Kw
Fuels & Combustion Engg.
2009.



5. (a) For igniting Stoichiometric Methane-air mixture at ambient pressure and temperature, determine minimum ignition energy (MIE). Take n = 2·2, C = 4, thermal conductivity of gas = kg = 0·08 W/mK, $C_p$ of gas = 1·1 kJ/kg K. Assume that the burning velocity of Stoichiometric Methane-air mixture at 0·1 MPa and 298 k is 38 cm/sec. If the pressure is reduced by three times, what will be the MIE ? Assume that adiabatic temp. $T_{ad}$ = 2300 K would not change with pressure. 10
   (b) Explain flame stabilization by burner rim. 6
   (c) State the assumptions to be considered for Laminar flame theory. 4

6. (a) In a Stoichiometric propane and air flame $N_2$ is replaced by Helium, whose original burning velocity $S_L$ is 40 cm/s. Estimate the laminar burning velocity of this new Stoichiometric mixture. 6
   (b) How the coal is classified ? State the application of each. 4
   (c) Illustrate the scope of combustion in modern times. 6
   (d) Explain the process of solid fuel combustion. 4

7. Write short notes on (any **five**) :— 20
   (a) Liquid fuel combustion.
   (b) Properties of liquid fuels that make them suitable depend on its application.
   (c) Effects of chemical and physical variables on burning velocity.
   (d) Different combustion modes.
   (e) Flame Extinction or quenching.
   (f) Types of burners used in industry.

---