



Note: Assume any data required, state your assumption clearly. Answer all the following Questions
Combustion tables are allowed

Question (1) (25 Marks)

- (1.1) Explain detonation, deflagration and Hugoniot curve. (10 Marks)
- (1.2) The lower calorific value of a liquid fuel at constant pressure is 44000 kJ/kg. The analysis of fuel by mass is 84% carbon and 16% hydrogen. Determine the higher calorific value at constant pressure and the lower and higher calorific values at constant volume. At 25 °C , h_{fg} for H₂O is 2442 kJ/kg. (15 Marks)

Question (2) (25 Marks)

- (2.1) Explain: Greenhouse effect, Dissociation, Endothermic, Exothermic, Activation energy and Bond energy. (10 Marks)
- (2.2) Calculate the adiabatic flame temperature when methane burns in the presence of air at constant pressure process at 600 K and 1 atm, having (a) 50% excess air and (b) 20% less air, leading to incomplete combustion. Calculate the loss of thermal energy due to incomplete combustion. Take the mean value of C_p for methane as 52.234 kJ/kmol. K. (15 Marks)

Question (3) (25 Marks)

- (3.1) Define the flame and explain its types. (10 Marks)
- (3.2) Explain: Quenching, Flammability and Flammability Limits. Also Prove that $d = \sqrt{b \delta}$ using simplified quenching analyses. (15 Marks)

Question (4) (25 Marks)

- (4.1) Defined : Ignition, (using simplified Ignition analyses) Prove that, (10 Marks)

$$E_{ign} = 61.6 P \left(\frac{C_P}{R_b} \right) \left(\frac{T_b - T_u}{T_b} \right) \left(\frac{\alpha}{S_L} \right)^3$$

- (4.2) Discuss the factors influencing flame velocity and thickness. (15 Marks)