

Answer the following questions.

- 1) A- Define: Auto Ignition Temperature, Flammability Limits, Smoke Point, Methane Number, Gibbs Function, Enthalpy of Formation, Chemical Kinetics, Quenching Distance, Calorific Value, and Minimum Ignition Energy. (10)
- B- Discuss the major parameters for boiler overall performance analysis? (5)
- 2) A- What are the major parameters needed to account the boiler heat balance? With the help of a flow diagram that shows the inputs and outputs of both heat and mass, into and out from the boiler respectively. (5)
- B- State briefly the factors affecting on the reaction rate? (5)
- C- State briefly how the combustion reaction proceed kinetically? (5)
- 3) A- State briefly the different devices used for flame studies? In this case state the flame classifications. (5)
- B- How burning velocity, quenching distance and minimum ignition energy are interrelated? In this case give brief description about the main factors affecting the quenching distance and minimum ignition energy. (5)
- C- Discuss the flame characteristics in terms of temperature and species distribution. (5)
- 4) A- A small gas turbine uses $C_8H_{18}(L)$ for the fuel and 400% excess air, the air and fuel enter at $25\text{ }^\circ\text{C}$, and the products of combustion leave at 900 K . The output of the engine and the fuel consumption are measured, and it is found that the specific fuel consumption is 0.25 kg/s of fuel per megawatt output. Determine the heat transfer from the engine per kilomole of fuel, the entropy and Gibbs function changes. Assume complete combustion. (5)
- B- In a test of a gas-turbine combustor, saturated-liquid methane at 115 K is to be burned with excess air to hold the adiabatic flame temperature to 1600 K . It is assumed that the products consist of a mixture of CO_2 , H_2O , N_2 , O_2 , and NO in chemical equilibrium. Determine the percent excess air used in the combustion, and the percentage of NO in the products. (10)