

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER-V (NEW) EXAMINATION – WINTER 2020****Subject Code:3150509****Date:22/01/2021****Subject Name:Fuels and Combustion****Time:10:30 AM TO 12:30 PM****Total Marks: 56****Instructions:**

1. Attempt any FOUR questions out of EIGHT questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) State the different characteristics of a good fuel required for combustion. **03**
 (b) Discuss in short about the scenario of coal reservoirs in India. **04**
 (c) Write in brief about the theories suggested by geologists regarding the mechanism of formation of coal. **07**
- Q.2** (a) Briefly explain various important properties of coal. **03**
 (b) State the different objectives and industrial applications of coal washing. **04**
 (c) Write a short note on origin of petroleum and natural gas. **07**
- Q.3** (a) Name the types of crude distillation methods used in petroleum industries. **03**
 (b) Enlist the refining products of petroleum. **04**
 (c) What are bio-fuels? Discuss in detail about the production process and technologies required for bio-fuels. **07**
- Q.4** (a) Name the various methods to produce the hydrogen gas. **03**
 (b) Briefly explain the storage and handling of acetylene gas. **04**
 (c) What is producer gas? Discuss the different reactions involved in the production of producer gas. **07**
- Q.5** (a) Explain the consequence of presence of nitrogen during combustion process. **03**
 (b) Define air to fuel ratio. Determine the air to fuel ratio when octane (C₈H₁₈) is burned with 200% theoretical air. **04**
 (c) The following is the ultimate analysis of a sample of petrol by weight: Carbon = 85%, Hydrogen = 15%. Calculate the ratio of air to petrol consumption by weight if the volumetric analysis of the dry exhaust gas is: CO₂ = 11.5%, CO = 1.2%, O₂ = 0.9%, N₂ = 86%. Also find percentage excess air. **07**
- Q.6** (a) Define calorific value, gross calorific value and net calorific value of fuel. **03**
 (b) Calculate the heating value of Methane. It may be assumed the methane is burnt in pure oxygen and does not contain any water vapour. The reaction stoichiometry is **04**
- $$\text{CH}_4 (\text{g}) + 2\text{O}_2 (\text{g}) \rightarrow \text{CO}_2 (\text{g}) + 2\text{H}_2\text{O} (\text{g})$$
- The heat of formation data are as follows: ΔH°_f of CO₂ (g) = -393.5 kJ/mol, ΔH°_f of H₂O (g) = -242.8 kJ/mol and ΔH°_f of CH₄ (g) = -74.8 kJ/mol
- (c) Derive the expression for the first law analysis of reacting system for the steady flow processes. **07**
- Q.7** (a) Briefly discuss the combustion of oil. **03**
 (b) State the two advantages and disadvantages of pulverized fuel firing. **04**
 (c) With neat sketch explain the concept of flame structure, propagation and **07**

flammability limit.

- Q.8** (a) List out the various characteristics of an efficient furnace. **03**
- (b) What do you mean by turn down ratio of burner? State the various types of gas burner with their applications. **04**
- (c) With neat diagram discuss the working and industrial applications of fluidized bed combustion process. **07**

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