

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 5 – EXAMINATION – SUMMER 2026

Subject Code: 3150509

Date: 21/05/2026

Subject Name: Fuels and Combustion

Time: 02:30 PM TO 05:00 PM

Total Marks: 70

Instructions:

- 1. Attempt all questions.**
- 2. Make suitable assumptions wherever necessary.**
- 3. Figures to the right indicate full marks.**
- 4. Simple and non-programmable scientific calculators are allowed.**

- Q.1**
- (a)** Define fuel and classify them using block diagram. **03**
 - (b)** Illustrate the stages of coalification with the help of a diagram. **04**
 - (c)** A sample of coal has the following composition by mass: Carbon (C) = 80%, Hydrogen (H) = 5%, Oxygen (O) = 6%, Sulphur (S) = 1%, Ash = 8%. Calculate the Gross Calorific Value (GCV) and Net Calorific Value (NCV) of the coal. **07**

- Q.2**
- (a)** Define rank of coal with neat flow chart. **03**
 - (b)** Describe in brief the Float and Sink test for coal washing with neat sketch. **04**
 - (c)** Explain proximate and ultimate analysis of fuel for the evaluation of various properties of coal. **07**

OR

- Q.2**
- (c)** Enlist different theories behind coal forming process. Describe in detail. **07**
- Q.3**
- (a)** Explain Long-Wall mining. **03**
 - (b)** Draw neat flow diagram for coal tar distillation. **04**
 - (c)** Describe F-T synthesis process for the production of gasoline via coal with neat block diagram. **07**

OR

- Q.3**
- (a)** Explain Short-Wall mining. **03**
 - (b)** Define oxy-rich combustion and discuss its significance. **04**
 - (c)** Describe Methanol to Gasoline process (MTG) for the production of clean gasoline via coal with suitable chemical reactions involved. **07**

- Q.4**
- (a)** Define LPG. List the various constituents of LPG. **03**
 - (b)** Write short notes on: (a) Refinery gas, (b) Blast furnace gas **04**
 - (c)** Describe the production of water gas with all chemical reactions involved. **07**

OR

- Q.4**
- (a)** Enlist the techniques used for the removal of dust and ash particles from fuel gases. **03**
 - (b)** Write short note on hydrogen as a clean fuel. **04**
 - (c)** Describe the formation of methane in coal mines. Discuss its applicability as a fuel with safety. **07**

- Q.5** (a) Discuss in short about the stoker firing. **03**
- (b) List out the various characteristics of an efficient furnace. **04**
- (c) On assuming complete combustion, a liquid fuel (1.000 kg basis) has the following elemental mass composition (dry, no free water): **07**

1. C = 0.840 kg
2. H = 0.120 kg
3. S = 0.002 kg
4. O = 0.020 kg
5. N = 0.018 kg

The dry air is having the molar composition of O₂ = 21.0% and N₂ = 79.0% (use the usual molar ratio N₂/O₂ = 3.76). The combustion is carried out at 1 atm and standard temperature for gas volumes at 25 °C (298.15 K), and volume V_m=24.465 m³/kmolV. Calculate the theoretical oxygen demand in kmol O₂ and stoichiometric air (kmol and kg) required for 1.000 kg fuel. Give the stoichiometric air/fuel mass ratio (A/F, mass basis).

OR

- Q.5** (a) Define stoichiometric air and excess air requirement for combustion. **03**
- (b) Explain turn down ratio of burner. State the various types of gas burner with their application. **04**
- (c) An ultimate analysis of gasoline sample gave carbon 85%, hydrogen 15%. Calculate the ratio of air to gasoline consumption by weight if the volumetric analysis of the dry exhaust gas is CO₂ = 11.5%; CO = 1.2%; O₂ = 0.9%; and N₂ = 86%. Also, determine the % of excess air required for complete combustion. **07**
