Seat No./Enrollment No.: _____

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 O_2 = 21.0% and N_2 = 79.0% (use the usual molar ratio N_2/O_2 = 3.76). The combustion is carried out at 1 atm and standard temperature for gas volumes at 25 °C (298.15 K), and volume Vm=24.465 m3/kmolV. Calculate the theoretical oxygen demand in kmol O_2 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**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V EXAMINATION – SUMMER 2025

Subject Code:3150509 **Date:13-05-2025**

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)**	State the types of mining and basic system of production techniques for mining.	**03**
	(b)	Cite any four industrial applications of coal washing.	**04**
	(c)	Discuss about the direct and indirect methods of coal liquefaction.	**07**
Q.2	**(a)**	State any three industrial examples of solid, liquid and gaseous fuels.	**03**
	(b)	Briefly explain the storage and handling of liquid fuels.	**04**
	(c)	Write a short note on different types of coal combustion techniques.	**07**
		OR	
	(c)	With neat sketch explain the drilling process of petroleum and natural gas.	**07**
Q.3	**(a)**	Enlist the refining products of petroleum.	**03**
	(b)	With suitable examples differentiate between agro fuels and bio fuels.	**04**
	(c)	Discuss about cleaning, purification and quality enhancement of gaseous fuels.	**07**
		OR	
Q.3	**(a)**	What is carbureted water gas? State the applications of carbureted water gas.	**03**
	(b)	Briefly explain the storage and handling of acetylene gas.	**04**
	(c)	Discuss the different reactions involved in the production of producer gas.	**07**
Q.4	**(a)**	Define stoichiometric air and excess air requirement for combustion.	**03**
	(b)	What is net and gross calorific value of fuel? How to determine the calorific value at constant temperature?	**04**
	(c)	What is adiabatic flame temperature? Derive an expression for constant pressure adiabatic flame temperature.	**07**
		OR	
Q.4	**(a)**	Define heat of combustion, heat of reaction and heat of formation.	**03**
	(b)	Differentiate between diffusion flames and premixed flames.	**04**
	(c)	Discuss the working principle and industrial applications of Fluidized bed combustion process.	**07**
Q.5	**(a)**	State the industrial applications of pulverized fuel firing.	**03**
	(b)	Briefly explain the mechanism and kinetics of combustion process.	**04**
	(c)	With neat sketch discuss the working mechanism and industrial applications of atmospheric gas burners.	**07**
		OR	
Q.5	**(a)**	Why do furnaces operate at low efficiency? What are the methods by which furnace efficiencies can be improved?	**03**
	(b)	State the two advantages and applications of walking hearth furnace.	**04**

(c) With neat sketch discuss the working mechanism and industrial applications of rotary cup burners. **07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – SUMMER 2024

Subject Code: 3150509 Date:16-05-2024

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.**

			MARKS
Q.1	**(a)**	Define fuel and classify them by making a tree diagram.	**03**
	(b)	Discuss various theories suggested by geologists regarding the formation of coal.	**04**
	(c)	Enlist any three properties of solid and liquid fuel. Also, Explain their measurement techniques in detail.	**07**
Q.2	**(a)**	Explain origin and classification of petroleum crude.	**03**
	(b)	Describe the process of coalification. State the rank of coal with a block diagram.	**04**
	(c)	Enlist the different objectives and industrial applications of coal washing. Describe in brief the Float and Sink test for coal washing with neat sketch.	**07**
		OR	
	(c)	Enlist coal combustion techniques. Explain fluidized bed combustion with neat sketch. Also, discuss the advantage of fluidized bed combustion over fixed bed combustion.	**07**
Q.3	**(a)**	Explain augur mining.	**03**
	(b)	Differentiate between direct and in-direct coal liquefaction process.	**04**
	(c)	Describe the vacuum distillation process with neat flow diagram.	**07**
		OR	
Q.3	**(a)**	Explain room and pillar mining.	**03**
	(b)	Briefly explain the storage and handling of acetylene gas.	**04**
	(c)	Explain the reforming of naphtha in detail with neat flow diagram.	**07**
Q.4	**(a)**	Define Biogas. Enlist the various steps involved in the biogas production.	**03**
	(b)	Explain the oxy-rich combustion and discuss its significance.	**04**
	(c)	Describe in detail about the production processes and technologies available for bio-diesel production.	**07**
		OR	
Q.4	**(a)**	Enlist various generations for bio-fuel production. Also, discuss the various challenges faced in using Ethanol as a fuel in India	**03**
	(b)	Explain turn down ratio of burner. State the various types of gas burner with their application.	**04**

	(c)	Define water gas. Describe the production of water gas with all reactions involved with schematic diagram.	**07**
Q.5	**(a)**	Define adiabatic flame temperature.	**03**
	(b)	Discuss the working and industrial application of traveling grate stoker boiler.	**04**
	(c)	A coal sample on analyzing by weight gave carbon 85%, hydrogen 6%, oxygen 6% and remaining are incombustible gases. Determine minimum weight of air required per kg of coal for chemically correct composition.	**07**

OR

Q.5	**(a)**	Define stoichiometric air and excess air requirement for combustion.	**03**
	(b)	Enlist various methods for hydrogen production. Explain any one in detail.	**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 CO_2 = 11.5%; CO = 1.2%; O_2 = 0.9%; and N_2 = 86%. Also, determine the % of excess air required for complete combustion.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER- V EXAMINATION-SUMMER 2023

Subject Code: 3150509 Date: 23/06/2023

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.**

			MARKS
Q.1	**(a)**	Define Fuel and discuss its classification with suitable example.	**03**
	(b)	Define flash point and fire point and explain the significance of both.	**04**
	(c)	Discuss in detail about the scenario of coal reservoirs in India. Also, state the consumption pattern of coal in India	07
Q.2	**(a)**	Explain the storage, handling and safety of gasoline.	03
	(b)	Describe devolatilisation of coal at different temperature range. Also Discuss the composition of volatile matter.	04
	(c)	Enlist the different theories behind the coal forming process. Describe anyone in detail.	07
		OR	
	(c)	Describe briefly MTG process. List out the advantages of ebulated bed reactor over the fixed bed reactor	**07**
Q.3	**(a)**	State the advantages and disadvantages of long-wall mining.	**03**
	(b)	Write a short note on accumulation of petroleum in sediments.	**04**
	(c)	Describe the vaccume distillation process with neat flow diagram	**07**
		OR	
Q.3	**(a)**	State the advantages and disadvantages of short-wall mining.	**03**
	(b)	Describe in brief the Float and Sink test for coal washing with neat sketch.	**04**
	(c)	Describe fluid catalytic cracking process in detail. Discuss the recent development in the catalysts for this process.	**07**
Q.4	**(a)**	Define. Biogas. Enlist the various steps involved in the biogas production.	**03**
	(b)	Explain the oxy-rich combustion and discuss its significance.	**04**
	(c)	Define bio-fuel. Describe in detail about the production processes and technologies available for ethanol production.	**07**
		OR	
Q.4	**(a)**	Define Agro fuels with two examples.	**03**
	(b)	Explain turn down ratio of burner. State the various types of gas burner with their application.	**04**
	(c)	Define producer gas. Discuss the different reactions involved in the production of producer gas.	**07**

Q.5	**(a)**	Define adiabatic flame temperature.	**03**
	(b)	Briefly discuss diffusion flames and premixed flames.	**04**
	(c)	A coal sample on analyzing by weight gave carbon 85%, hydrogen 6%, oxygen 6% and remaining are incombustible gases. Determine minimum weight of air required per kg of coal for chemically correct composition.	**07**

OR

Q.5	**(a)**	Discuss in short about the stoker firing.	**03**
	(b)	List out the various characteristics of an efficient furnace.	**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 CO_2 = 11.5%; CO = 1.2%; O_2 = 0.9%; and N_2 = 86%. Also, determine the % of excess air required for complete combustion.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V(NEW) EXAMINATION – SUMMER 2022

Subject Code:3150509 Date:02/06/2022

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)**	Cite any three industrial examples of solid, liquid and gaseous fuels.	**03**
	(b)	State the various properties and its measurement techniques for liquid fuels.	**04**
	(c)	What is coal liquefaction? Why it is required? Discuss the direct and indirect process of coal liquefaction.	**07**
Q.2	**(a)**	Compare storage & handling of solid and liquid fuels.	**03**
	(b)	Write a technical note on the properties & testing of petroleum products.	**04**
	(c)	Discuss the different types of coal combustion techniques.	**07**
		OR	
	(c)	What is dewaxing? Discuss the different types of dewaxing processes.	**07**
Q.3	**(a)**	State the storage, handling and safety for acetylene gas.	**03**
	(b)	Differentiate between steam reforming and partial oxidation process for producing hydrogen gas.	**04**
	(c)	What is producer gas? Discuss the different reactions involved in the production of producer gas.	**07**
		OR	
Q.3	**(a)**	Cite any three industrial applications of bio fuels.	**03**
	(b)	What are agro fuels? Explain the storage & handling procedure of agro fuels.	**04**
	(c)	Discuss the production process, technologies and applications of bio fuels.	**07**
Q.4	**(a)**	State the mechanism and kinetics of combustion process.	**03**
	(b)	Derive the equation for constant pressure adiabatic flame temperature.	**04**
	(c)	Gasoline is burned steadily with air in jet engine. Determine the air to fuel ratio and the percentage excess air used for combustion. Assume the complete combustion of gasoline.	**07**
		OR	
Q.4	**(a)**	State the charecteristics of a good combustion process.	**03**
	(b)	What is dew-point temperature? Explain the method to determine the dew-point temperature of the combustion products.	**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: CO_2 = 11.5%; CO = 1.2 percent; O_2 = 0.9%; N_2 = 86%. Also find percentage excess air.	**07**
Q.5	**(a)**	State any three potential applications of oxygen rich combustion.	**03**
	(b)	Briefly explain the working principle of fluidized bed combustion process.	**04**
	(c)	Derive the expression for the first law analysis of reacting system for the steady flow processes.	**07**

OR

Q.5	**(a)**	Define turn down ratio of burner. State the various types of gas burner with their applications.	**03**
	(b)	Name the various types of furnace and explain the working of any one.	**04**
	(c)	With neat sketch discuss about the structure and propagation for laminar premixed flame.	**07**

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