Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–V EXAMINATION – WINTER 2025

Subject Code:3150509 Date:17-11-2025

Subject Name:Fuels and Combustion

Time:10:30 AM TO 01:00 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)**	Draw a line diagram for the classification of fuel.	**03**
	(b)	Define octane number and cetane number and discuss their significance.	**04**
	(c)	Discuss in detail about the present scenario of crude oil refineries in India. Also, state the consumption pattern of petroleum crude in India.	**07**
Q.2	**(a)**	Explain the term coal mining. Enlist various types of coal mining.	**03**
	(b)	Differentiate between direct and Indirect coal liquefaction processes with suitable examples.	**04**
	(c)	Enlist various coal combustion technologies. Explain circulating fluidized bed combustion technique for the combustion of bituminous coal.	**07**
		OR	
	(c)	Describe briefly H-coal process. List out the advantages of ebulated bed reactor over the fixed bed reactor	**07**
Q.3	**(a)**	Write short note on exploration of crude petroleum.	**03**
	(b)	Explain vis-breaking. Also list the various products of vis-breaking unit.	**04**
	(c)	Describe vacuum distillation unit with neat flow sheet for crude distillation.	**07**
		OR	
Q.3	**(a)**	Write short note on improved oil recovery (IOR).	**03**
	(b)	Explain hydro-cracking. Also list the various products of hydro-cracking unit.	**04**
	(c)	Describe delayed coking process used in the petroleum refinery with neat flow sheet.	**07**
Q.4	**(a)**	Define agro fuel with suitable examples.	**03**
	(b)	Explain the storage, handling and safety of water gas.	**04**
	(c)	Describe the synthesis of producer gas with all the chemical reactions involved and flow diagram.	**07**

OR

Q.4	**(a)**	Define biogas with its chemical composition.	**03**
	(b)	Explain the storage, handling and safety of acetylene gas.	**04**
	(c)	Enlist the various methods for the production of hydrogen gas. Describe the steam reforming process for the synthesis of hydrogen with all the chemical reactions involved.	**07**
Q.5	**(a)**	Enlist the various characteristics of an efficient furnace.	**03**
	(b)	State the two advantages and disadvantages of pulverized fuel firing.	**04**
	(c)	Write short note on adiabatic flame temperature, calorific value of coal, air to fuel ratio and dew point of products.	**07**

OR

Q.5	**(a)**	Define oxy-rich combustion.	**03**
	(b)	Define turn down ratio of burner. State the various types of gas burner with their applications.	**04**
	(c)	Discuss the working and industrial application of traveling grate stoker boiler.	**07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3150509 Date:25-11-2024

Subject Name:Fuels and Combustion

Time:10:30 AM TO 01:00 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)**	Explain Seismic geophysical work in drilling operation.	**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)**	Define coal liquefaction process. Enlist various types of liquefaction process.	**03**
	(b)	Explain float and sink method for coal washing.	**04**
	(c)	Enlist various coal combustion technologies. Explain circulating fluidized bed combustion technique for the combustion of bituminous coal.	**07**
		OR	
	(c)	Define coal mining. Explain Long wall coal mining in detail.	**07**
Q.3	**(a)**	Explain augur mining.	**03**
	(b)	Explain vis-breaking. Also list the various products of vis-breaking unit.	**04**
	(c)	Explain the reforming of naphtha in detail with neat flow diagram.	**07**
		OR	
Q.3	**(a)**	Write short note on improved oil recovery (IOR).	**03**
	(b)	Explain the coal tar distillation process with neat sketch and also name the various products obtained during this process.	**04**
	(c)	Describe delayed coking process used in the petroleum refinery with neat flow sheet.	**07**
Q.4	**(a)**	Define calorific value, gross calorific value and net calorific value of fuel.	**03**
	(b)	State the potential benefits of oxygen enrich combustion over conventional air-fired combustion process.	**04**
	(c)	Describe the synthesis of producer gas with all the chemical reactions involved and flow diagram.	**07**
		OR	
Q.4	**(a)**	State the mechanism and kinetics of combustion process.	**03**
	(b)	Define agro fuels. Explain the storage & handling procedure of agro fuels.	**04**
	(c)	Define water gas. Describe the production of water gas with all reactions involved.	**07**
Q.5	**(a)**	Enlist the various characteristics of an efficient furnace.	**03**

	(b)	State the two advantages and disadvantages of pulverized fuel firing.	**04**
	(c)	A petrol sample on analyzing by weight using an ultimate analysis gave carbon 85%, hydrogen 15%. Calculate the ratio of air to fuel by weight if volumetric analysis of the dry exhaust gas include CO_2;11.5%, CO;1.2%, O_2;0.9% and N_2; 86%. Also find % excess air.	**07**

OR

Q.5	**(a)**	Define adiabatic flame temperature.	**03**
	(b)	Enlist various methods for hydrogen production. Explain any one in detail.	**04**
	(c)	Discuss the working and industrial application of traveling grate stoker boiler.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2023

Subject Code:3150509 Date:05-12-2023

Subject Name: Fuels and Combustion

Time:10:30 AM TO 01:00 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)**	What is coal mining? State the types of mining and basic system of production techniques for mining.	**03**
	(b)	Discuss about the measurement techniques for petroleum fractions.	**04**
	(c)	With neat sketch explain the drilling process of petroleum and natural gas.	**07**
Q.2	**(a)**	What is carbonization? How it is being carried out? State the different types of carbonization.	**03**
	(b)	Briefly describe the gasification process for coal.	**04**
	(c)	Discuss the different types of coal combustion techniques.	**07**
		OR	
	(c)	Name the methods to assess the quality of coal and explain any one in detail.	**07**
Q.3	**(a)**	State the different types of refinery equipments along with their uses.	**03**
	(b)	Write a brief note on storage and handling of liquid fuel.	**04**
	(c)	What is dewaxing? Discuss the different types of dewaxing processes.	**07**
		OR	
Q.3	**(a)**	Briefly explain the different reaction occur during the steam reforming.	**03**
	(b)	Discuss about the safety and handling of acetylene gas.	**04**
	(c)	What is water gas? Discuss the different reactions involved in the production of water gas.	**07**
Q.4	**(a)**	List out the various characteristics of a good fuel.	**03**
	(b)	Explain the handling and storage of agro fuels.	**04**
	(c)	Classify the bio fuels. Discuss the production process, technologies and applications of bio fuels.	**07**
		OR	
Q.4	**(a)**	Write down the basic chemical equations for complete combustion of fuel.	**03**
	(b)	Derive the equation for constant pressure adiabatic flame temperature process.	**04**
	(c)	A petrol sample was found to have 86% carbon and 14% hydrogen by mass. When used in an engine the air supply is 90% of that theoretically required for complete combustion. Assuming that all the hydrogen is burnt and that the carbon burns to carbon monoxide and carbon dioxide so that there is no free carbon left, calculate the percentage analysis of dry exhaust gases by volume.	**07**
Q.5	**(a)**	List out the factors affecting the rate of combustion process.	**03**
	(b)	Briefly explain about flame structure, propagation and flammability limit.	**04**
	(c)	Determine the air–fuel ratio on both a molar and mass basis for the complete combustion of octane, C_8H_{18}, with (i) the theoretical amount of air and (ii) 150% theoretical air (50% excess air).	**07**

OR

Q.5	**(a)**	State any three industrial applications of batch and continuous furnaces.	**03**
	(b)	Explain the working of fluidized bed combustion process.	**04**
	(c)	Define enthalpy of combustion and formation. Derive the expression for the first law analysis of reacting system for the steady flow processes	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3150509 Date:04-01-2023

Subject Name:Fuels and Combustion

Time:10:30 AM TO 01:00 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 various important properties of coal.	**03**
	(b)	Write a short note on scenario of coal reservoirs in India.	**04**
	(c)	State the different types of coal combustion techniques and explain any one in detail.	**07**
Q.2	**(a)**	State the characteristics of good fuel.	**03**
	(b)	Enlist the refining products of petroleum.	**04**
	(c)	Write in brief about the proximate and ultimate analysis of coal.	**07**
		OR	
	(c)	Write a short note on accumulation of petroleum in sediments.	**07**
Q.3	**(a)**	State the objectives of coal washing.	**03**
	(b)	Write a short note on agro fuels.	**04**
	(c)	Discuss in brief about production processes and technologies for bio-fuels.	**07**
		OR	
Q.3	**(a)**	Define adiabatic flame temperature and dew point temperature.	**03**
	(b)	Write in short about thermodynamic heat of combustion.	**04**
	(c)	The CO_2 content of the products of complete combustion of a coal of 7,200 kcal/kg CV is 12 % by orsat analysis. Calculate: (a) % excess air (b) volume of air supply at 30 ^oC and 760 mmHg and (c) volume of the flue gas leaving the furnace at 400 ^oC and 760 mmHg per kg of coal fired.	**07**
Q.4	**(a)**	Discuss in short spontaneous ignition temperature.	**03**
	(b)	Explain with neat sketch the atmospheric gas burner.	**04**
	(c)	State the types of combustion process and explain any one in detail.	**07**
		OR	
Q.4	**(a)**	State the various types of coal burning equipment.	**03**
	(b)	State various types of gas burner.	**04**

	(c)	Give the detailed classification of furnaces and discuss the different types of batch furnace.	**07**
Q.5	**(a)**	Discuss in short about the stoker firing.	**03**
	(b)	Write in short about storage and handling of liquid fuels.	**04**
	(c)	Write in brief about velocity of flame propagation.	**07**

OR

Q.5	**(a)**	State the disadvantages of crude coal tar as a furnace fuel.	**03**
	(b)	Explain with neat sketch the pot type burner.	**04**
	(c)	Methane (CH_4) is burned with atmospheric air. The molar analysis of the products on a dry basis is as follows: CO_2 = 10%, O_2 = 2.37%, CO = 0.53%, N_2 = 87.10%. Calculate the air – fuel ratio and the percent theoretical air required for complete combustion.	**07**

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