Total number of printed pages: 02 **PG/2nd Semester/PGET2102**

2023

Fuels and Combustion

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer question **one** is compulsory and answer any **four** from the rest*

1.	Give short answers for the following questions (answer any ten):		2x10 = 20
	a)	What is combustion?	
	b)	Define primary and secondary fuel.	
	c)	Define calorific value of a fuel.	
	d)	What is 1 Kcal? 1Kcal = ____?__ cal	
	e)	What is gross calorific value?	
	f)	What is net calorific value?	
	g)	Distinguish between Intrinsic and Extrinsic ash.	
	h)	Define flash point.	
	i)	What is ignition temperature?	
	j)	What are the calorific values of bituminous and anthracite coal?	
	k)	What is coking coal??	
	l)	Define syn gas.	
	m)	What is sweeting of fuel?	
	n)	Give the increasing order of thermal capacity for aromatics, naphthalene, paraffin.	
	o)	Fill in the blanks: Petroleum is complex mixture of _____, _____, _____ and _____ .	
2.			
	a)	A coal has the following composition by weight: C= 92%, O= 2.0%, S= 0.5% N= 0.5% and Ash= 1.5% Net calorific value of the coal was found to be 9,430 kcal/kg. Calculate	4+4 = 8

		the percentage of hydrogen and HCV of coal.	
	b)	Write short notes on moisture content of coal on the basis of proximate analysis.	4
	c)	Give the classification of crude petroleum. Define paraffin wax and asphalt.	2+2 = 4
	d)	Define cracking of a fuel. Show the rupture of C-C and C-H bonds in $C_{10}H_{22}$.	1+3= 4
3.	Distinguish between the following (answer any four)		5x 4= 20
	a)	Thermal cracking and catalytic cracking	
	b)	Low temperature carbonization and high temperature carbonization	
	c)	Water gas and producer gas	
	d)	Net calorific value and gross calorific value	
	e)	Flash point and boiling point of fuel.	
4	**a)**	What do you mean by coal liquefaction process? What are direct and indirect liquefaction?	2+4 = 6
	b)	Write the characteristics of good fuel.	4
	c)	Write short notes on ash content in proximate analysis. What are the two classes of ash?	3+2 = 5
	d)	Give the classification of coal. How will you discuss the progressive transformation of wood to anthracite?	2+3 = 5
5	**a)**	Give the Dulong's formula for calculating the calorific value of a fuel in terms of HCV and LCV as well.	5
	b)	Show the water gas shift reaction with a proper schematic diagram.	5
	c)	Show the mechanism of thermal cracking of n-nonane.	5
	d)	Explain Bergius process of hydrogenation of coal to gasoline with proper schematic diagram.	5
6.	**a)**	Show the mechanism of catalytic cracking of an alkene.	5
	b)	"All coking coals are caking but all caking coals are not essentially coking coals." Explain the statement.	5
	c)	Transition metals are used as catalyst in water gas shift reaction. Give the reaction with proper explanation.	5
	d)	Define ultimate and proximate analysis of coal.	5