Vellore Institute of Technology

Final Assessment Test – November 2024

Course: BCHE314L - Fuels and Combustion

Class NBR(s): 3312

Slot: G1+TG1

Time: Three Hours

Max. Marks: 100

- **KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

General Instructions: Steam tables permitted

Answer ALL Questions

(10 X 10 = 100 Marks)

1. The composition of a refinery gas by volume H_2=74%, CH_4 = 13.5%, C_2H_6 = 7.4%, C_3H_8 = 3.6%, nC_4H_{10} = 1.2% and nC_5H_{12} = 0.3%

Data:

Component	GCV, kJ/mol	NCV, kJ/mol
CH_4	890.65	802.62
C_2H_6	1560.17	1428.64
C_3H_8	2219.17	2043.11
nC_4H_{10}	2877.40	2657.32
nC_5H_{12}	3535.77	3271.67

ΔH_f of H_2O (g) = -241.82 kJ/mole at 298 K

ΔH_f of H_2O (l) = -285.83 kJ/mole at 298 K

Calculate gross calorific value and net calorific value of the refinery gas in kJ/mol and kJ/kg

2. Draw a schematic diagram of Orsat's apparatus and explain how flue gas analysis is done.
3. Discuss in detail the history of coal formation with different stages of transformation.
4. Briefly explain the advantages and disadvantages of solid fuel
5. What is the composition of crude oil? Explain the principle involved in fractional distillation of crude oil. Mention the various fractions obtained in this process and their industrial uses.
6. Mention different types of reforming. Illustrate any one commercial reforming process to produce gasoline.
7. What is producer gas? Discuss the different reactions involved in the production of producer gas.
8. The coal feed to a producer analysis as 70 % carbon, 3.5 % moisture, 7.5 % ash, and negligible nitrogen and sulfur. The product gas analysis as 8% CO_2, 16.3% H_2, 20.6% CO, 1% CH_4, and 54.1 % N_2. Calculate the cold gas efficiency of the producer in percentage.

   Data:

   The calorific value of gas is 27195 kcal/kmol

   The calorific value of coal is 7489.4 kcal/kg

9.a) A sample of oil fuel was found to be composed of 80% carbon and 20% hydrogen. If 6.25% of the carbon contained in one kg of fuel is burned to carbon monoxide due to incomplete combustion and the remainder to carbon dioxide and if 40 percent excess air was supplied per kg of fuel burnt, determine

(i) The theoretical air required for complete combustion of 1 kg of oil fuel

(ii) The excess oxygen in the flue gases per kg of oil fuel burnt,

(iii) The percentage analysis on a mass basis of the total products of combustion

OR

9.b) The following is the percentage composition of coal on mass basis:
C = 90, H_2 = 3.3, O_2 = 3, S = 0.9 and remainder ash. Calculate

(i) The theoretical air required to burn 1 kg of coal completely

(ii) The percentage composition of dry flue gases on mass basis if 50% excess air is supplied.

10.a) List out types of atomizing burners. Explain the working principle of any two with a neat sketch.

OR

10.b) Discuss production the processes and technological aspects of various biofuels from different waste sources.

⇔⇔⇔ K/L/TX ⇔⇔⇔