Final Assessment Test - November 2016

Course: **CHE2006 - Fuels and Combustion**
Class NBR(s):**2134 / 2456** Slot: **E1+TE1**
Time: **Three Hours** Max. Marks: **100**

Answer any TEN Questions
(10 X 10 = 100 Marks)

1. a) With a neat diagram describe how the calorific value of a solid fuel is determined Using Bomb calorimeter. **[6]**

   b) Write Dulong's formula. Coal has the following composition by weight carbon 90%, oxygen 3.0%, sulphur 0.5%, and ash 2.5%. Net calorific value of the coal was found to be 8,490.5 Kcal/kg. Calculate the % age of hydrogen and higher calorific value of coal. **[4]**

2. A sample of finely ground coal of mass 0.9945 g was placed in a crucible of 8.5506 g in an oven, maintained at 105°C for 1 hr. The sample was then removed, cooled in a desiccator and reweighed; the procedure being repeated until a constant total mass of 9.5340 g was attained. A mass of 1.0120 g in a crucible of mass 8.5685 g was heated with a lid in a furnace at 920°C for 420 s. On cooling and reweighing, the total mass was 9.1921 g. This sample was then heated without a lid in the same furnace maintained at 725°C until a constant total mass of 8.6255 g was attained. Calculate the proximate analysis of the sample and express the results on "as sampled" and "dry, ash-free" basis.

3. What are the advantages of clean coal? With help of neat diagram explain any four methods of coal washing process.

4. What is meant by knocking? Describe the function of TEL. Explain octane number, Cetane number, pour point, aniline point, diesel index.

5. What are the classifications of crude oil? With a neat diagram explain atmospheric distillation and vacuum distillation unit for refining of crude petroleum? Mention the application of various fractions obtained from petroleum? (Guest Lecture)

6. With a neat diagram explain the manufacture of metallurgical coke by Otto Hoffmans oven method. What is crude oil?

7. Write a note on Fluid catalytic cracking (FCCU) with diagram. What are the various fractions obtained from petroleum?

8. Cetane is burnt with 15% excess air. Calculate the following:
   (i) Air/fuel ratio by weight
   (ii) Air/fuel ratio by volume
   (iii) Weight of dry exhaust gas formed per unit weight of fuel
   (iv) Mole of O_2 in the exhaust per unit weight of fuel
   (v) Mole of water vapor in the exhaust per unit weight of fuel
   (vi) Volume of exhaust gas at 1atm at 260°C per unit weight of fuel.

   Specific gravity of cetane is 0.784.

9. Calculate the GCV and NCV at 298K of the gas having the following composition by volume. Specific volume of gas at 298K and 101.325 KPa = 24.465 m^3/Kmol

Calculate GCV and NCV in KJ/mol, KJ/Kg, and KJ/m^3.

Component	GCV KJ/mol	NCV KJ/mol
CH_4 =74.4%	890.65	802.62
C_2H_6=8.4%	1560.69	1428.64
C_3H_8 =7.4%	2219.17	2043.11
i-C_4H_{10}=1.7%	2868.20	2648.12
n-C_4H_{10}=2.0%	2877.40	2657.32
i-C_5H_{12}=0.5%	3528.83	3264.73
n-C_5H_{12}=0.4%	3535.77	3271.67
N_2=4.3%	-	-
CO_2=0.9%	-	-

10. Define Gross and net calorific value of a fuel. The ultimate analysis of coal sample is given as Carbon = 61.5%, Hydrogen = 3.5 %, Sulphur = 0.4 %, Ash = 14.2 %, Nitrogen = 1.8 %, and rest oxygen. Calculate

    i) Theoretical oxygen requirement per unit weight of coal.

    ii) Theoretical dry air requirement per unit weight of coal.

    iii) The analysis of flue gas composition.

11. How do internal combustion engines cause air pollution? How can the internal combustion engines be modified to make auto-exhaust free from pollution?.

12. List out sources of air pollution, briefly discuss about the various types of air pollutants, and its effects on human health?

13. Explain in detail about any three methods with neat diagram used for estimating the pollutants in air.

⇔⇔⇔