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## UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination – December 2017

|   |            |         |
|---|------------|---------|
| Program/course: B. Tech (ET+IPR)        | Semester – | V       |
| Subject: Combustion Energy & Technology | Max. Marks | : 100   |
| Code : ETEG303                          | Duration   | : 3 Hrs |
| No. of page/s: 02                       |            |         |

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\*The question paper consists of three sections. Answer the questions section wise in the answer booklet.

**Note:** Assume suitable data wherever necessary. The notations used here have the usual meanings.

### SECTION – A (Total Marks: 4 x 5 = 20)

➤ Attempt all the questions.

**Q.1** Calculate the heat of formation of gaseous ethanol at 298.15 K from its elements using the following data:

Data: Heat of formation of  $\text{CO}_{2(g)}$  = -393.51 kJ/mol

Heat of formation of  $\text{H}_2\text{O}_{(l)}$  = -285.83 kJ/mol

Heat of combustion of gaseous ethanol at 298.15 K = -1410.09 kJ/mol [05]

**Q.2** Explain about the calorific value of fuel. [05]

**Q.3** Distinguish between solid fuels and liquid fuels. [05]

**Q.4** Discuss about the adiabatic flame temperature. [05]

### SECTION – B (Total Marks: 4 x 15 = 60)

➤ Attempt all the questions.

**Q.5** What are the various gaseous fuels available in the market? Explain in detail the manufacturing process of water gas along with its applications.

[15]

**Q.6** What is the importance of catalytic cracking process in the refinery? Explain the process of fluidized catalytic cracking with neat schematic diagram. [15]

**Q.7** Explain the following terms in brief:

- a) Ultimate analysis of coal [05]
- b) Drift theory of coal formation [05]
- c) Bituminous coal [05]

**Q.8 a)** Calculate the gross and net calorific value of a coal which analyses:

Carbon - 74%, Hydrogen - 6%, Nitrogen - 1%, Oxygen - 9%, Sulphur - 0.8%, moisture - 2.2% and ash - 7%. [05]

b) Write down about the uses of coal and various petroleum products. [10]

**SECTION – C (Total Marks: 1 x 20 = 20)**

➤ Attempt ***any one*** the questions.

**Q.9** The ultimate analysis of a residual fuel oil (RFO) sample is as given below:

C: 88.4%, H: 9.4% and S: 2.2% (by weight)

It is used as a fuel in a power generating boiler with 25% excess air.

Calculate: a) the theoretical oxygen requirement, b) the theoretical dry air requirement, c) Equivalence ratio and d) The Orsat analysis of flue gases [20]

**Q.10** Methanol is being burnt as a fuel, both methanol and air are available at 298 K. If 40% excess air is supplied, calculate the adiabatic flame temperature assuming the complete combustion.

[20]

Data: i) Net calorific value of methanol at 298 K = 638100 J/mol

ii) Heat Capacity data,  $C_p^0 = a + bT$

| Component | a | b x 10 <sup>3</sup> |
|-----------|---|---------------------|
|-----------|---|---------------------|

|                  |         |         |
|------------------|---------|---------|
| CO <sub>2</sub>  | 37.174  | 23.2371 |
| H <sub>2</sub> O | 25.1584 | 21.2818 |
| O <sub>2</sub>   | 18.4331 | 21.7174 |
| N <sub>2</sub>   | 31.1182 | 3.1969  |