M.Tech(ME) 2nd Semester Examination
June 2014
Fuels, Combustion & Environment
Subject Code: MEL-502

Before answering the question paper the candidate should ensure that they have been supplied the correct question paper. Complaints in this regard, if any, shall not be entertained after the examination.

Note: First question is compulsory. Attempt two questions from each section A and B.

1(a) Name the main classification of coal. (b) Explain rate of reaction. (c) What is theoretical air? What is excess air factor? (d) What is Gibbs function? [20]

SECTION-A

2(a) Explain flash point, specific heat & calorific value for a fuel with proper example. [10]

(b) What is the typical reaction under which a nuclear power plant operates? What is the issue faced with this type of reaction & how this is controlled? Explain with proper diagram. [10]

3(a) A certain reaction proceeds through time “t” in first order kinetics. The half life of the reaction is 180 seconds. What percent of initial concentration remains after 900 seconds? [10]

(b) Answer the following:- [5 x 2 = 10]

i. What is meant by combustion instability?

ii. Elaborate the calculation for theoretical flame temperature?

4. The specification of a fuel oil is given below:-

<table>
<thead>
<tr>
<th>Constituents</th>
<th>% By Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>86</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>11.9</td>
</tr>
<tr>
<td>Oxygen</td>
<td>0.7</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>0.5</td>
</tr>
<tr>
<td>Sulphur</td>
<td>0.5</td>
</tr>
<tr>
<td>Water</td>
<td>0.35</td>
</tr>
<tr>
<td>Ash</td>
<td>0.05</td>
</tr>
</tbody>
</table>

GCV of fuel is 10880 kcal/kg. Calculate the constituent of flue gas with excess air? [20]

SECTION-B

5(a) Explain three flame regimes in a turbulent flame? [10]

(b) Describe in detail the factors influencing flame velocity? [10]

6. Determine the flue gas analysis & air-fuel ratio by weight when a medium viscosity fuel oil with 84.9% carbon, 11.4% hydrogen, 3.2% sulphur, 0.4% oxygen & 0.1% ash is burnt with 20% excess air. Assume complete combustion. [10]

7. A coal with a dry, ash-free composition of 0.87 C, 0.09 H2, 0.02 S, and 0.02 O2 is burned with 25% excess air. The as-fired ash and moisture contents are 6% and 4%, respectively.

a. What are the stoichiometric and actual air-fuel ratios? [10 x 2 = 20]

b. What is the flue gas composition?