Centre for Energy Studies
ESL-711 Fuel Technology
Major Test

Time : 2 hrs.

Part - A : Marks : 20

1. Coal analysis shows (% by weight)

   C = 68, N = 1.9, S = 0.3 and ash 14.7

   After combustion the dry refuse removed from the furnace showed a combustible content of 40% carbon. Calculate :

   i. The kg of carbon burnt
   ii. Volume of air consumed in combustion of 100 kg coal
   iii. % volumetric composition of flue gas (1.5 +1.5 + 2 = 5)

2. Discuss combustion process with stationary flames clearly differentiating premixed, diffusion, laminar and turbulent stationary flames. (5)

3. Say 'True' or 'False' :

   i) Use of too excess steam beyond an optimum supply in an air blown gasifier increases the total content of combustibles in producer gas.
   ii) Complete gasification of coal in a single stage process maximizes the yield of gaseous products and minimizes the formation of tar.
   iii) Lurgi process is high pressure fluidized bed gasification to obtain increased CH_4 content in the producer gas.
   iv) L-shaped curve obtained for washability characteristic curve indicates high proportion of middlings present in coal.
   v) In Indian coal classification system, the code no. 4803 indicates that coal is high moisture, high volatile, low rank, non-caking coal.
   vi) In passing from coals of low rank to high rank, caking power decreases and oxygen content increases.
   vii) To produce coke from coal, the processes used are high temperature carbonization and Lurgi spul gas process.
   viii) A level II coal preparation plant involves crushing, screening and coarse coal cleaning.
   ix) In Seyler's coal classification system Isocals and Isovols are parallel to each other.
   x) During weathering of coal size is reduced and calorific value is increased.
   xi) During storage coal is either adequately ventilated or closely compacted to avoid spontaneous combustion of coal.
   xii) In dense-media washer for coal, the liquid medium used should be capable of forming a stable separation medium over the wide range of the desired sp.gr.
   xiii) In washability test of a certain sp.gr. of a liquid, the increment curve indicates the variation of ash from particle to particle in the increasing order of higher sp.gr.
   xiv) The sp.gr. of a medium with 20% water and 80% minerals of 2.6 sp. gr. is found out to be 2.8.
   xv) The highest carbon monoxide content in producer gas can be obtained by using thicker fuel bed, low temperature and adequate contact time.

xvi) Among updraft moving packed bed, downdraft moving packed bed and fluidized bed gasifiers, the cleanest gas is obtained from downdraft moving packed bed gasifier.

xvii) In winklers' process fuel bed temperature is maintained at 1600°C and the ash is removed as molten slag.

xviii) Volatile matter of coal consists of inherent moisture, gases, tarry vapours and other organic compounds.

xix) A typical washery data shows (% by wt.)
Yield of clean coal with 12 % ash = 67.7 %
Yield of Middlings with 30 % ash = 16.5 %
Yield of Rejects with 65 % ash = 15.8 %
The ash content in the raw coal is calculated to be 23.3 g.

xx) Peat and lignites are considered to be low rank coals. (10)

Part - B : Marks : 20

1. Describe the process of hydrocracking of heavy oils. (2)

2. Write short notes on the following topics:

   a) LPG
   b) Winkler process of gasification of coal. (5)

3. Answer yes or no/True of False

   i) Cetane number of gasoline is poor.
   ii) Lube oil is mostly aromatic
   iii) LNG and LPG are same
   iv) Control rods and moderators are used in handling MSW
   v) Platforming is used for the production of gas hydrates
   vi) Pet coke and soft coke are same. (3)

4. In a trial coal gasifier the following results were obtained :

Gas yield	=	4500 Nm^3/ton of coal
Calorific Value of Coal	=	5600 Kcal/kg
Calorific value of gas obtained	=	1210 Kcal/Nm^3

   Calculate the cold gas efficiency. (5)

5. Calculate the gross calorific value and Wobbe index of a fuel gas having the following composition (% by volume) and calorfic values (CVs).

Methane	= 82 %, CV of methane = 9500 kcal/Nm^3
Ethane	= 15 %, CV of ethane = 16,644 kcal/Nm^3
Propane	= 2 %, CV of propane = 23,688 kcal/Nm^3
Butane	= 1 %, CV of butane = 30,714 kcal/Nm^3

(5)