

VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, BURLA
DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING
SESSION 2016 - 17 (ODD SEMESTER)

Total Pages—5

(Set-T₁)

B.Tech-3rd (M&M)
Fuel, Furnace and Refractories

Full Marks : 70

Time : 3 hours

Answer six questions including Q. No. 1
which is compulsory

The figures in the right-hand margin indicate marks

Symbols carry usual meaning

1. Answer *all* questions : 2 × 10
- (a) What is the difference between the adiabatic and theoretical flame temperature ?
- (b) Write the different methods that are used for the determination of spontaneous ignition temperature of vapors and gases.
- (c) Calculate the amount of air required for theoretically complete combustion of 100 Nm³

(Turn Over)

(2)

of blast furnace gas of the following composition :

$\text{CO}_2 = 18\%$, $\text{CO} = 22.1\%$, $\text{H}_2 = 4.9\%$,
 $\text{N}_2 = 55.8\%$, $\text{O}_2 = 0.2\%$.

- (d) What are the main characteristics that are considered for selecting a burner for a particular operation ?
 - (e) Write down the heat input and heat output items that are taken into consideration for the heat balance calculation of a furnace.
 - (f) Explain the properties of Mullite.
 - (g) What do you mean by Gasification of coal ?
 - (h) What are the allotropic forms of silica bricks and what is its allotropic temperature ?
 - (i) What is the difference between formed coke and ferrocoke ?
 - (j) What do you mean by metal clad ?
2. (a) Briefly describe the burner design parameters for waste heat recovery of conventional industrial furnaces.

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- (b) Classify the furnaces based on basis of heat source, fuels, heat transfer, heat saving appliances, mode of operation and draught. 5
3. (a) The flue gas from an industrial furnace has the following composition by volume : $\text{CO}_2 = 11.73\%$, $\text{CO} = 0.2\%$, $\text{N}_2 = 0.09\%$, $\text{O}_2 = 6.81\%$ and $\text{N}_2 = 81.17\%$. Calculate the percentage of excess air employed in the combustion, if the loss of carbon in clinker and ash is 1% of the fuel used and the fuel has the following composition by weight : 5
- $\text{C} = 74\%$, $\text{H}_2 = 5\%$, $\text{O}_2 = 5\%$, $\text{N}_2 = 1\%$,
 $\text{S} = 1\%$, $\text{H}_2\text{O} = 9\%$ and ash = 5%
- (b) What is the method of burning a gaseous fuel? What is the design data required for aerated atmospheric gas burner? 5
4. (a) When the products of combustion of a coal are analyzed it gives $\text{CO}_2 = 14.5\%$, $\text{O}_2 = 4.7\%$ and $\text{N}_2 = 80.8\%$ by volume. Calculate the per cent of excess air required for the combustion of coal which contains : 5

C = 67.9%, H = 4.4%, S = 0.8%, N = 16%,
O = 7.9%, ash = 4.5% and water = 12.9%
if burnt inside a furnace.

- (b) Write the different methods for burning a liquid fuel like oil and explain the different types of atomizing oil burners. 5
5. (a) Explain the properties and uses of Graphite refractory. 5
- (b) Why spalling occurs in case of silica bricks and how we can reduce the spalling? 5
6. (a) What is Carbonization? What is the difference between low temperature carbonization and high temperature carbonization? 5
- (b) Explain proximate analysis of coal. 5
7. (a) Explain physical and chemical properties of metallurgical coke. 5
- (b) Explain the use of refractory in non-ferrous metal industry. 5

(5)

8. Write short notes on any *two* :

5 × 2

- (i) Limits of inflammability
 - (ii) Ignition temperature
 - (iii) Cermets
 - (iv) Soaking pit.
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