

Total Pages—5

(Set-R₂)

B.Tech-6th
Refractories and Furnaces

Full Marks : 70

Time : 3 hours

**Q. No. 1 is compulsory and answer
any five from the rest**

The figures in the right-hand margin indicate marks

1. Answer *all* the questions : 2 × 10
- (a) What is solid and liquid fuel ?
 - (b) What is refractory ? Give the classification of refractories.
 - (c) Explain the factors deciding the choice of refractory for a particular furnace.
 - (d) What do you mean by flame ? Explain it in detail.

(Turn Over)

(2)

- (e) What do you mean by theoretical adiabatic and true flame temperature ?
 - (f) Draw the unary phase diagram of silica.
 - (g) Define fuel efficiency. How does it vary with flue gas temperature ?
 - (h) What is SIALON ? How is it produced ?
 - (i) Describe various modes of heat losses from a furnace.
 - (j) What is a furnace ? Write the difference between recuperator and regenerator.
2. (a) A coal has following proximate analysis on air dried basis, M = 1.5%, A = Ash = 15.5% VM = volatile matter = 28%, FC = Fixed Carbon = 55%. Calculate its ash% on dry basis and volatile matter on dry ash free and dry mineral matter free basis. 5
- (b) What do you mean by coal and coke ? Explain LTC and HTC process of coke making and write advantage of HTC over LTC. 5

(3)

3. (a) Explain the characteristic properties of magnesite, magnesite-chrome and carbon bricks. 5
- (b) Describe the composition, properties and area of application of high alumina refractory and chrome magnesite. 5
4. (a) What are the dolomite, silica and fireclay refractories? Describe its composition, properties and area of application. 5
- (b) Mention the refractories used in different parts of iron blast furnace, coke oven and copper converter. 5
5. (a) Describe the refractories used in different parts of electric arc furnace, reheating furnace and muffle furnace. 5
- (b) What do you mean by binary diagram? Draw the binary diagram of $\text{Al}_2\text{O}_3 - \text{SiO}_2$ and explain it in detail. 5
6. (a) What do you mean by limit of inflammability? A gas mixture containing

35% H₂, 55% CO, and 10% CH₄. The lower (L_1) and upper (L_2) limit of inflammability of the gases CO, H₂ and CH₄ in air are (13.5, 5 and 6.55) and (64, 65 and 14) respectively. Then calculate the limit of inflammability. 5

(b) Draw the schematic diagram of cupola furnace and explain the working principle of the same. Write advantage and disadvantage of cupola furnace. 5

7. (a) Differentiate the terms furnace and oven. Classify the furnace on the basic of application and heating method. 5

(b) What do you mean by complete and incomplete combustion? Write the different stoichiometric equation by weight and by volume of C, CO, S and CH₄ for the complete combustion. 5

8. (a) What do you mean by pyrometric cone equivalent? Describe the pyrometric cone equivalent test. 5

(5)

(b) The flue gas from the industrial furnace have the following composition by volume :

$\text{CO}_2 = 74\%$, $\text{CO} = 0.2\%$, $\text{H}_2 = 0.09\%$,
 $\text{O}_2 = 6.81\%$ and $\text{N}_2 = 81.17\%$. Calculate the percentage excess air employed in the combustion, if loss of carbon in clinker and ash is 1% of the fuel used and the fuel has the following composition by weight :

$\text{C} = 74\%$, $\text{H}_2 = 5\%$, $\text{O}_2 = 5\%$, $\text{N}_2 = 1\%$,
 $\text{S} = 1\%$, $\text{H}_2\text{O} = 9\%$, and $\text{Ash} = 5\%$. 5