

College of Engineering, Pune
(An Autonomous Institute of Government of Maharashtra)
End Semester Examination
(MT 304) - (FURNACE TECHNOLOGY)
Semester – I

Year: T.Y.B-Tech
Academic Year: 2013-14
Duration: 3 Hours

Branch: Metallurgy
Date: Nov 2013
Max Marks: 50

Instruction to candidates:

1. Solve ANY FIVE questions.
2. Neat Diagrams must be drawn wherever necessary.
3. Figures to the right indicate full marks.

Q.1 A) Explain the role of excess air in furnace efficiency. [6]

B) A flat furnace wall is made of 115 mm layer of refractory brick ($K = 0.12 \text{ kcal / hr m}^\circ \text{C}$)
baked by a 230 mm layer of common brick ($K = 1.2 \text{ kcal / hr m}^\circ \text{C}$) [4]

Find out—

- a) The heat flux
- b) Interface temperature between refractory and common brick. Furnace wall inside and outside temperature are 760 and 75°C respectively.

Q.2 A) Explain the importance of Grog in firebrick manufacturing. [3]

B) Atmospheric Air contains

	Oxygen	Nitrogen	Sulphur
By Volume			
By Mass			

C) Define the following terms:- [5]

1. Caking and Coking of Coal
2. Aniline Point
3. Acid Dew point
4. Excess Air
5. Black Body

Q.3 A) Draw flow sheet showing various steps involved in manufacturing of Refractories. [5]

B) Draw equilibrium diagram of $\text{Al}_2\text{O}_3 - \text{SiO}_2$ system and show various refractory locations along X-axis. [5]

.4 State **True OR False** and Justify your answer. (No marks without proper justification) ANY 3 [6]

- A)
1. As the % S in the fuel increases Acid Dew point decreases.
 2. Flue gas temperature should be below Acid Dew Point temperature.
 3. In Radiation pyrometer, the readings are independent of the distance between pyrometer and hot body.
 4. Conduction is a faster process of heat transfer than others in the same range of temperatures.

B) Give note on Carbon refractory manufacturing. [4]

Q.5 A) The 3 phase Direct Arc steel making furnace takes an average current of 40,000 ampere at a potential of 380 volt between the conductors to feed its graphite electrodes. Power factor 0.8. Melting and refining are completed in 5 hours. Electrode consumption is 5 kg/ton of the steel melt (60 % to CO and remaining burns to CO₂) releasing 9.25 and 32.70 MJ/Kg heat respectively. The heat of melting of steel 1356 KJ/Kg. The sensible heat of gases leaving the furnace 1200 KJ/Kg of gas mixture (CO + CO₂). Ignore the heat carried away by N₂ in flue gas. Cooling water used 100 m³/hr. Rise in temperature is 15⁰K. Electrical losses amount to 4 % of the electrical input. Steel charge is 150 tons.
Prepare the accurate heat balance in MJ units.
Express the heat balance data in terms of % heat input.
Comment on whether Heat Balance is Within Normal Limit OR Not? [10]

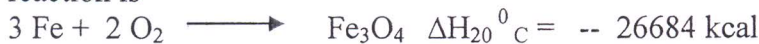
A) Using following data prepare a Heat Balance for a steel ingot Soaking Pit for a twenty hours test period during which 140 tons of ingot were heated from 20⁰ C to 1220⁰ C [10]

Mean Temperature of :

1. Air after **Air recuperator**: 600⁰C
 2. Blast Furnace gas(Fuel) after **Gas recuperator** : 500⁰C
 3. Flue gases after soaking pit : 1100⁰ C
 4. Flue gases after Air recuperator : 800⁰ C
 5. Flue gases after **gas recuperator** : 300⁰ C
 6. Average Blast furnace gas consumption: 2805 m³/hr
 7. Air/ Fuel gas ratio : 0.8
 8. Flue gas/ Fuel gas : 1.65
 9. Calorific Value of Blast Furnace gas : 860Kcal/m³
 10. Mean Specific heats (kcal/m³-⁰C) →
- (all volumes are measured at 1 atm, 20⁰C)

Air	0.305
Blast F/c gas	0.309
Flue gas	0.363
Sp. heat of steel	0.180 (kcal/Kg- ⁰ C)

Scale formation 2.5 % by weight. Scale formation reaction is



Atomic weight of Iron = 56, Structural losses = 270 KW

Calculate thermal Efficiency of Soaking Pit, Thermal efficiency of both Air and Gas recuperator, and also find % unaccounted losses.
