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#### MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING APPLIED SCIENCE AND TECHNOLOGY

**DEPARTMENT: MINING AND MINERAL PROCESSING ENGINEERING**

**MODULE: METALLUGY OF IRON AND STEEL**

**CODE: ENGM 316,HMME511**

### SESSIONAL EXAMINATIONS

**DECEMBER 2023**

**DURATION: 3 HOURS**

**EXAMINER: MR S CHISHIRI**

## INSTRUCTIONS

1. *This paper consist of* ***one*** *section with* ***five*** *questions*
2. *Answer question* ***one*** *and any* ***other three.***
3. *Start a new question on a fresh page.*
4. *Total marks 100*

***Additional material(s):*** *Calculator*

**QUESTION 1**

1. The Zimbabwean Ripple Creep deposit has some soft limonite which are friable and generates many fines during the mining process. These fines are known to produce sinter of poor quality. Pelletization can be an alternate process of preparing this ore for the Blast Furnace reduction process. With the aid of a well labelled diagram, discuss in detail the pelletization process to produce carbon composite pellets using this ore and state the advantages of using these pellets. **[20 marks]**
2. Describe and explain the importance of the beneficiation processes in iron ore preparation,  **[5 marks]**

**QUESTION 2**

1. Describe why and how phosphorus is removed from molten iron. **[5 marks]**
2. Blast furnace produces pig iron of composition Fe 94%, Si 2%, Mn 0.5%, and C3.5% by reduction smelting of iron ore, coke, and limestone. The analysis is as follows:

Iron Ore : Fe2O3 78%, SiO2 8%, Al2O3 5%, MnO 2%, H2O 7%

Coke: 86% C and 10% S and 4% Al2O3. Amount is 600 kg per ton of pig iron.

Limestone: Pure CaCO3 to produce a slag of 45% CaO

Calculate:

1. Amount of ore/ton of pig iron stating the assumption(s) made. **[5 marks]**
2. % of total SiO2 and of the MnO reduced in the furnace **[10 marks]**

1. What are the advantages of using the humidified blast in the blast furnace iron making process? **[5 marks]**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **C** | **O** | **Mn** | **Si** | **Ca** | **Al** | **H** | **Fe** | **S** |
| **Mr** | **12** | **16** | **55** | **28** | **40** | **27** | **1** | **56** | **32** |

**QUESTION 3**

1. What is the difference between direct reduction process (DRI) and smelting reduction (SR) in iron making? **[5marks]**
2. Discuss the main environmental pollutants that are emitted in any 3 sub processing plants in iron and steel making. **[10 marks]**
3. What is the main purpose of pre-treating molten iron before the oxidizing process in steel making? Why is the oxidation process important in the basic oxygen furnace? **[10 marks]**

**QUESTION 4**

1. List and explain any 3 types of blast furnace irregularities and their remedies

**[9 marks]**

1. Give a brief description of the continuous casting process and explain the benefits offered by continuous casting that are not achieved by ingot casting?

**[10 marks]**

1. Using simple calculations, discuss why the shaft of the Blast Furnace is the larger zone in design of the furnace**. [6marks]**

**QUESTION 5**

1. Differentiate between pig iron, cast iron and steel. **[6 marks]**
2. Describe the properties and functions of coke in the blast furnace.

**[10 marks]**

1. Explain the role of a basic oxidising slag in steel making. **[4 marks]**
2. Describe and explain the properties of blast furnace liners. **[5 marks]**

**END OF EXAMINATION**