NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONS) DEGREE
Part Five Examination May 2012

TCE5007 Advanced Minerals Engineering

Duration of Examination 3Hours

Instructions to Candidates

1. Answer any **FOUR** questions.
2. Show all your steps clearly in your calculation.
3. Start the answers for each question on a new page.

---

1. a) The sulphur content in coke is of major concern in the iron making industry, due to the detrimental effects of sulphur in iron. Removal of sulphur is normally carried out during the coal preparation stage. Describe a typical process that can be used to reduce sulphur content in raw coal. [5]

   b) The reducibility of iron ore is an essential characteristic for blast furnace operation, high reducibility results in low coke rates and hence higher productivity. State five factors which affect the reducibility of iron ore and explain their effects on reducibility. [10]

   c) Calculate the raw material rates/100 kg sinter produced, given the following data;

   (i) sinter basicity = 1.5
   (ii) FeO in sinter = 8 %
   (iii)coke/fuel rate = 9 kg/100 kg of sinter
   (iv) iron ore = heamatite concentrates
   (v) fluxing reagents = limestone ($CaCO_3$)
   (vi)10 % of the fuel is SiO_2 and 5% is Al_2O_3 [10]

2. a) Describe and explain how coke rate and fuel efficiency affect blast furnace productivity. [5]

b) Using your knowledge of thermodynamics and reaction kinetics, describe and explain the reactions that take place in the blast furnace:
(i) Upper zone [7]
(ii) Middle zone [3]
(iii) Lower zone [10]

3. a) What is the purpose of steelmaking and how is it achieved? [7]

b) Give a detailed description of one pyrometallurgical method of the extraction of zinc from a ZnS concentrate, include any pre-treatment processes. [10]

c) The presence of impurities during electrolytic processing of zinc causes a number of operational problems. With the aid of a flow diagram describe and explain the different purification steps, that are employed in order to reduce the levels of impurities in the electrolyte. [8]

4. a) Loss of copper to the slag phase in copper smelting is to be kept to a minimum at all times. Give a detailed analysis of the conditions required to create a clear-cut matte-slag phase, thus minimizing copper losses. [15]

b) What are the effects of magnetite in copper matte smelting? Which operational conditions should be adhered to in order to minimize the formation of magnetite? [5]

c) Compare and contrast the reverberatory and the flash smelting furnaces? [5]

5. a) Pyrometallurgy and hydrometallurgy are the two major methods of extraction of minerals from ore. Based on your analysis of the two methods, which of these two has a better future with regards to the economics of the process, effects on the environment and any other major issues of concern in mineral processing. [10]

b) Describe the process of bacterial leaching of copper sulphide ores. [10]

c) What are the principles of electrolytic copper refining? [5]

END OF EXAM