FACULTY OF SCIENCE & TECHNOLOGY

#### MIDLANDS STATE UNIVERSITY

Mining and Mineral Processing Engineering Department

Introduction to Mining and Metallurgy

CODE: HMIE 215

SESSIONAL EXAMINATIONS

December 2016

**DURATION: 3 HOURS**

**EXAMINERS: Mr. L. Chipise**

**Dr. A. Mamuse**

## INSTRUCTIONS

1. *Answer any* ***FIVE*** *questions.*
2. *Each question carries 25 marks.*

**SECTION A**

1. The identification of seismic discontinuities at various depths within the Earth has been instrumental in deducing the subdivisions of the Earth’s interior.

a) Briefly explain how seismic discontinuities arise (5)

b) List five of the seismic discontinuities known within the Earth (5)

c) Summarize the seismological evidence used to infer the subdivisions of the Earth’s silicate mantle and metallic core (10)

**SECTION B**

2.Write an essay on the evolution of the theory of plate tectonics (20)

3. a) Name the eight main tectonic plates as currently known (4)

b) With the aid of diagrams, describe the three main types of plate boundary (9)

c) Write brief notes on the three suggested driving mechanisms of plate tectonics listed below and state the order of their relative importance (7)

(iii) mantle drag

 (i) ridge push

(ii) slab pull

**SECTION C**

4. a) Define the following terms as they are used in mineralogy:

i) specific gravity (2)

ii) diad axis (2)

iii) parallel growth (2)

iv) mineraloid (2)

v) acicular crystal habit (2)

vi) vitreouslustre (2)

b) In what ways is mineralogy useful to:

i) mining engineers? (4)

ii) metallurgists? (4)

5. Minerals are commonly classified according to the dominant anion or anion group.

a) How can the diversity and abundance of silicate minerals be explained? (5)

 b) Giving mineral examples, write brief notes on the mineral classes or subclasses below

i) native elements (3)

ii) oxides (3)

iii) sulphides (3)

iv) carbonates (3)

vi) tectosilicates (3)

**SECTION D**

6. You are provided with hand specimens of two igneous rocks. Describe the rocks by completing the table below. (20)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Hand Specimen ID | Colour | Grain size (coarse, medium, fine) | Quartz (%) | Total feldspar (%)  | Dark (mafic) minerals (%) | Suggested rock name |
| R01 |  |  |  |  |  |  |
| R02 |  |  |  |  |  |  |

**SECTION E**

7.Sedimentary rocks can begrouped into four broad categories on the basis of their origin.

a) List and describe the four broad categories of sedimentary rocks. (8)

b) Name two sedimentary rock examples in each category in (a) and write brief notes on each of the named sedimentary rocks. (12)

**SECTION F**

8. a) Write concise notes on the following:

i) contact metamorphism (2)

ii) metasomatism (2)

iii) retrograde metamorphism (2)

iv) polymetamorphism (2)

v) greenschistfacies (2)

b) Briefly describe five metamorphic rock types of your choice (10)

**SECTION G**

9. a) In structural geology, folds can be placed into tightness classes using the size of the inter-limb angle.

i) With the aid of a diagram, define ‘inter-limb angle’ with respect to fold classification. (2)

ii) What are the fold tightness classes recognised in structural geology? (6)

b) A fault plane has a strike of 45⁰.

i) What are the two possible dip directions of the fault plane? (1)

ii) Given that the fault is a reverse fault and that its plane has a dip of 28⁰, what special name is given to such a fault? (1)

c) What is the distinction between faults and joints in structural geology? (2)

d) Name and describe 4 types of foliation in rocks. (8)

**SECTION H**

10. a) With the aid of diagrams describe 4 types of unconformity. (8)

b) Write brief notes on the following principles of stratigraphy:

i) original horizontality (2)

ii) original lateral continuity (2)

iii) faunal succession (2)

iv) cross-cutting relationships (2)

c) Discuss the role of fossils in stratigraphic correlation. (4)

**END OF QUESTION PAPER**

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**SECTION A**

**Question 1**

1. Mineral deposits can be classified according to the genesis or concentration process of the ore they contain. List and describe any *five* genetic classes of mineral deposits. **[10]**
2. Describe a classification system for mineral resources and mineral reserves.

 **[8]**

1. Describe the geological processes of petroleum generation and accumulation.

 **[7]**

**Question 2**

The Redwing Gold Mine in the Mutare Greenstone Belt, Zimbabwe is historically a significant producer of gold. Using information gathered from lectures and from the visit to Redwing Gold Mine, write concise notes on the following:

1. Geology of Redwing Gold Mine, **[8]**
2. Gold mineralization of Redwing Mine, and **[9]**
3. Mineral resources and reserves of Redwing Mine. **[8]**

**SECTION B**

**Question 3**

1. Describe the following three methods of pillar extraction:
2. Pillar splitting
3. Pillar stripping
4. Split and Fendering **[10]**
5. What are the advantages of having more than one exit in a mining operation?

 **[3]**

c) Why is Long Wall Mining preferred to Room and Pillar methods? **[7]**

**Question 4**

1. What parameter determines the size of extraction in open-pit mining? **[2]**
2. An excavation is producing pillar strengths of 10 MPa i.e. each pillar can support a load of 10 MN/m2 before failing. The pillars are 14 m2, the rooms are 6 m wide and the depth below the surface is 100 m. *(The density of the overburden is 2.5 t/m3*)

i. Find the safety factor. **[10]**

ii. What is the percentage extraction? **[4]**

iii. Justify the importance of strict adherence to a stipulated safety factor. **[4]**

##### SECTION C

**Question 5**

1. Describe Dump Leaching and highlight its advantages and disadvantages. **[10]**
2. In mineral processing circuit design, why would a combination of SAG mills and ball mills be preferred to rod mill-ball mill combination? **[3]**
3. How do you decide on the final particle size for milling processes? **[2]**
4. Why would a metallurgical organization implement a briquetting technology in the mineral beneficiation circuit? **[5]**

**Question 6**

1. Calcination, roasting and drying are pretreatment processes in Pyrometallurgy.
	* 1. Which of the three processes will be most suitable where electricity costs are very high? Justify your answer. **[3]**
		2. Which of the three processes will be least suitable where electricity costs are very high? Justify your answer. **[3]**
2. You are the technical consultant of a mining operation seeking to produce as fine as possible concentratesusing milling. Two milling options are available: Rod mill and ball mill. Advice and justify on the more suitable type of mill. **[4]**
3. What factors influence the choice of leaching reagent in hydrometallurgical operations? **[5]**
4. What is the difference between matte smelting and reductive smelting? **[5]**

**END OF QUESTION PAPER**