

THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF MINING ENGINEERING

FIRST SEMESTER EXAMINATION – 2021

THIRD YEAR MINERAL PROCESSING ENGINEERING

**MP323 – PHYSICAL PROCESSING AND METALLURGICAL
ACCOUNTING**

DATE: FRIDAY 11TH JUNE 2020

TIME: 12:50 PM

TIME ALLOWED: 3 HOURS

INSTRUCTION TO CANDIDATES:

1. YOU HAVE 10 MINUTES TO READ THE PAPER. DO NOT WRITE DURING THIS PERIOD
2. THERE ARE FIVE QUESTIONS. ATTEMPT ALL. WRITE ANSWERS IN THE ANSWER BOOKLET PROVIDED.
3. WRITE YOUR NAME AND NUMBER CLEARLY ON THE ANSWER BOOK. DO THIS NOW.

MARKING SCHEME:

THE QUESTIONS CARRY EQUAL MARKS. TOTAL MARK IS 100

QUESTION ONE

- (a) Jaw and gyratory crushers are employed for primary crushing duties. Provide clear distinctions between these crushers (6 marks)
- (b) Precisely differentiate between SAG mill and ball mill (5 marks)
- (c) State and discuss the mechanisms of grinding in tumbling mills (5 marks)
- (d) Ball mills are often operated in closed-circuit in mineral processing plants. Explain why? (4 marks)

QUESTION TWO

- (a) Discuss with aid of diagram, the principle employed by flowing film concentrators to concentrate minerals. Clearly show the effects of specific gravity, size and shape on mineral particles undergoing separation (4 marks).
- (b) Discuss with aid of diagram the jigging cycle (5 marks)
- (c) With aid of diagram discuss the operating principle of shaking table and state at least four (4) operational factors that affects shaking table concentrators (5 marks)
- (d) State the principle of dense medium separation and discuss the main characteristics that the media used must possess (6 marks)

QUESTION THREE

- (a) With aid of graph, illustrate how the following minerals would behave when introduced to a magnetic field;
 - (i) Ilmenite ($TiFeO_2$)
 - (ii) Quartz (SiO_2)
 - (iii) Black sands (magnetite)

State why they behave in such manner? (7 marks)

- (b) Explain what is hysteresis (3 marks)

- (c) With aid of diagram, discuss the operating principle of photometric ore sorting and state the common minerals processed by ore sorters (5 marks).
- (d) Discuss the operating principle of electrostatic separators and state its major disadvantage in industry application (5 marks)

QUESTION FOUR

- (a) Select any two (2) classifiers from the list of classifiers below and discuss their operating principles with aid of diagrams where necessary (10 marks);

- (i) hydraulic classifier
- (ii) rake classifier
- (iii) hydrocyclone
- (iv) setline cone

- (b) A particular gold deposit with an average grain size of $150\mu\text{m}$ is found to be closely associated with fine magnetite (Fe_3O_4). Other associated gangue minerals include quartz, serpentine, mica, pyrite and clayey minerals. As a metallurgist, you're to process this ore to recover the gold.

- (i) State the suitable recovery technique for this gold. Provide explanation for your choice (3 marks)
- (ii) The clayey minerals may present problem in the processing of gold. How do you address this issue? (3 marks)
- (iii) Magnetite maybe required removal to avoid dilution of the gold concentrate. With aid of a process flowsheet, clearly state how you would remove the magnetite (4 marks)

QUESTION FIVE

Perform metallurgical balance of Copper Concentrator in Table 1 and determine the following

- (a) The mass flow rates (tph) of each process streams (10 marks)
- (b) The copper distribution of the plant (12 marks)

- (c) The overall copper recovery and grade (3 marks)

Table 1 – Plant Survey data

| Streams | Tonnage | Raw chemical assay |
|------------------------|---------|-----------------------|
| | tph | Cu (%) |
| Flotation feed | 1000 | 1.4 |
| Rougher concentrate | | 10.1 |
| Rougher tail | | 0.1 |
| Cyclone overflow | | 5.6 |
| Cyclone Underflow | | 14.5 |
| Regrind Mill Discharge | | 14.5 |
| Column Cell Feed | | 10.1 |
| Column Concentrate | | 50.0 |
| Column Tail | | 3.5 |
| Cleaner Bank Feed | | 3.5 |
| Cleaner Tail | | 0.245 |
| Cleaner Con | | 47.8 |
| Final Con | | 48.9 |

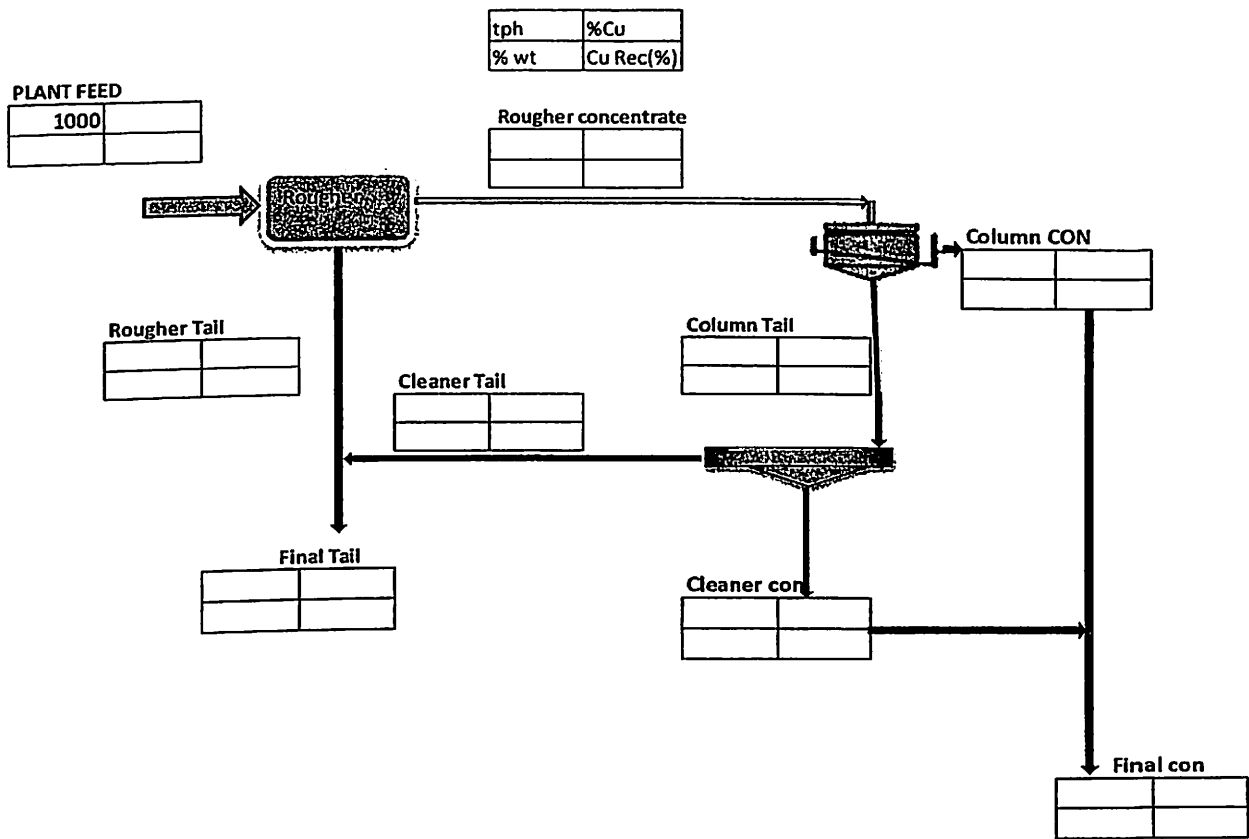


Fig. depicting the process flowsheet

.....**GOOD LUCK....END OF EXAM**.....