THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF MINING ENGINEERING

2021 SECOND SEMESTER EXAMINATION

Third Year Mining Engineering

MN323 – APPLIED GEOMECHANICS

DATE: Friday **05th October 2021**

TIME: **12:50 P.M.**

TIME ALLOWED: **3 HOURS**

INFORMATION FOR CANDIDATE:

1. You have ten minutes to read this question paper. You **SHOULD NOT** begin writing during this period.

2. There are **THREE** Questions to this paper. **YOU ARE TO ANSWER ALL THE QUESTIONS.**
3. Marks for each question is as indicated after question.

4. ALL answers must be written on the answer booklet provided. No other written materials will be accepted.

5. Write your **NAME** and **STUDENT NUMBER** clearly on the **ANSWER BOOK. DO THIS NOW.**

6. You **MUST NOT LEAVE** the room in the first hour.

7. All **MOBILE PHONES, AUDIO PLAYERS, MP3, MP 4 etc.. MUST BE SWITCHED OFF.**

Question 1 *30 marks*

A) Write short notes on any **FIVE** of the following. **MUST** provide diagrams and equation to aid your explanation ..... *15 Marks*

i) Conventional methods and Numerical methods of slope stability analysis

ii) Simplified Bishops method of slope stability analysis

iii) Effects of water on the slope stability

iv) Plan failure and Circular failure

v) Rock bolts

vi) Stereographic projection and limit equilibrium analysis

vii) Effect of cohesion and friction angle on slope stability

viii) Conditions of plan failure

B) Read The follow statement carefully and write them as true or false and explain your answers clearly.....*15 Marks*

a) As the rock mass behind each slope is unique, standard answers about their stability are available.
b) Vast sums of money can be saved by flattening of slopes
c) Water is the biggest enemy of slopes
d) The plane on which sliding occurs must strike nearly parallel to the slope face, for plane failure conditions
e) The angle of internal friction of failure plane must be greater than the dip angle of that plane, for a plane failure to occur.

Question 2 *30 marks*

A)

I) Economics of open pit mining operation is basically defined by the amount of waste stripped to uncover certain amount of ore. As the deposit depth increases, the amount of waste to be removed in order to access the ore increases. This results in the key issue of pit slope design.

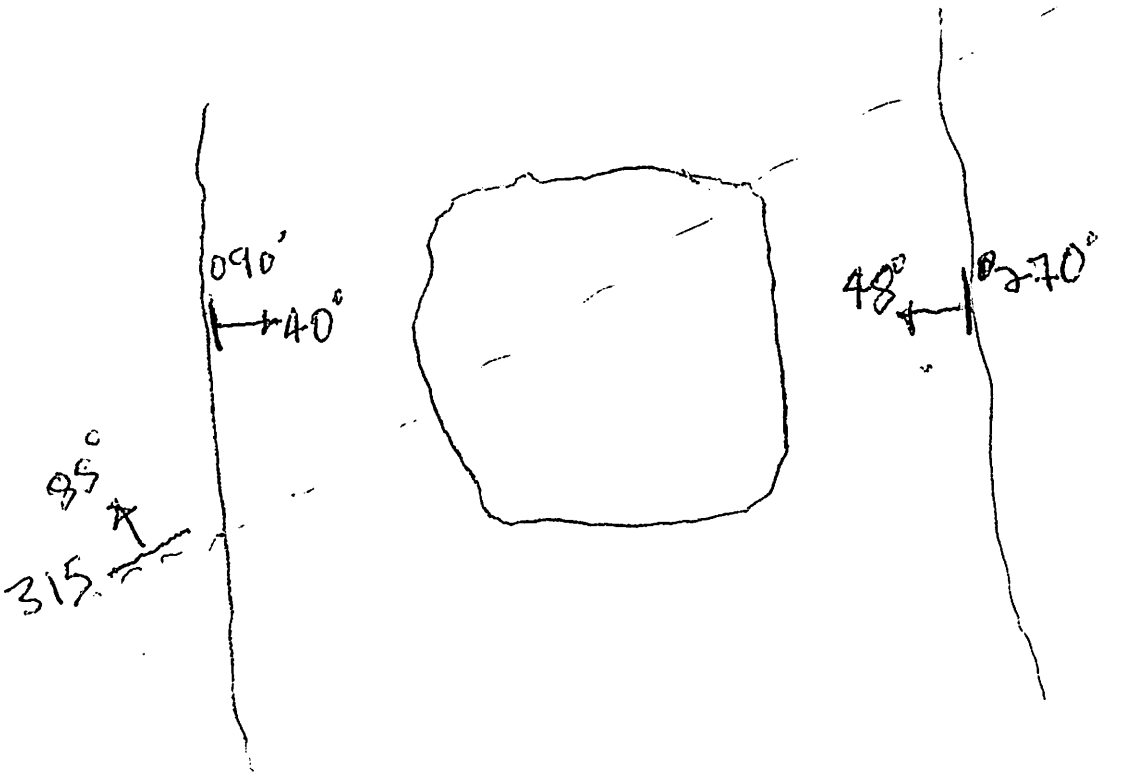
By your understanding, briefly discuss the pit slope design formulation and the pit slope design process. Also discuss the refinement of the process in each stages of the process from pre-feasibility studies to final bankable feasibility study stages.

..... *10 marks*

II) An Open pit mine is located with an overall slope angle of 45° on both sides of the pit. The strike length of the ore body is 1249 m and the ultermate depth of the pit is decided at 239 m. On the basis of the geotechnical investigations, it is decided to increase the slope to 46° on the foot wall side and decrease to 45° on the hanging wall side. Calculate the over all difference in the amount of waste to be handled in the mine and mention whether it is more or less then the original estimates. .....*5 marks*

C) The sketch below shows the location of a proposed open pit bottom and the presence of two major fault structures. .....*15 Marks*

1. Design a suitable orientation/layout of the pit
   - Proposed design pit slope is 50 degrees
2. Plot the pit slope and the major structures on the stereonet.
3. Evaluate the stability of your slope
4. Propose any modification of your design to stabilize the slope
5. Provide plans and cross sections of your proposed design.



Question 3 *40 marks*

Q1. A)

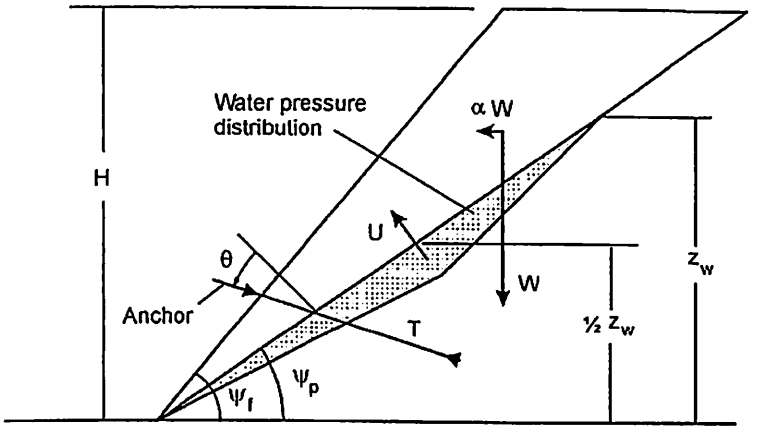


Figure 1.

Figure 1 shows the geometry of a plane failure without a tension crack. Derive the following:

a) An equation to calculate the factor of safety
b) Equation to calculate the contact area, **A**
c) Equation to calculate the unit weight of the block, **W**
d) Equation to calculate the uplifting water pressure, **U.**

..... *20 marks*

B) The following **figure 2** shows the cross – section of a rock slope with a fault plane BE dipping at 27^0. A vertical tension crack GD, situated 14 m behind the crest K is assumed to be saturated. The water pressure along BD is taken to vary linearly from zero at B to full hydrostatic pressure at D. The unit weights of rock and water are 26.5 and 9.7 kN/m^3 respectively. The fault plane has strength parameters, cohesion C = 93 kPa and friction angle = 22°. Determine the factor of safety against sliding of the mass BKGD

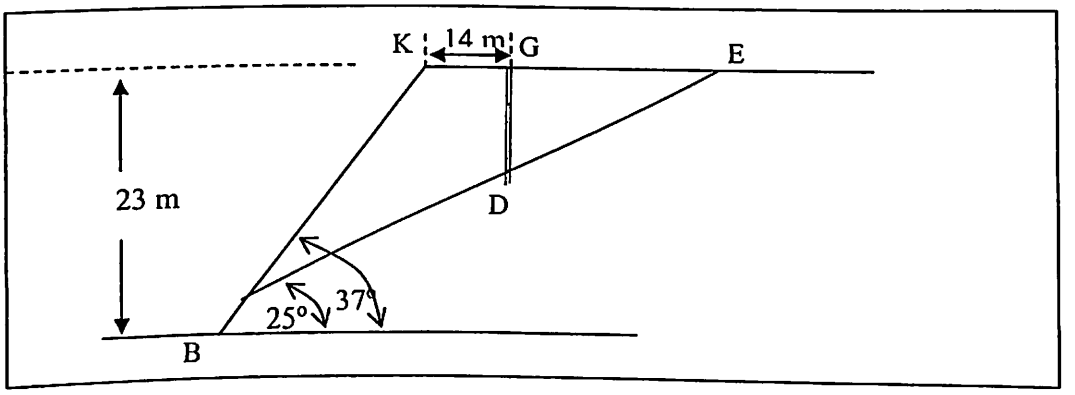


Figure 2.

..... **20 marks**