NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

DEPARTMENT OF MINING AND PROCESS ENGINEERING

QUALIFICATION : BACHELORS OF ENGINEERING IN MINING ENGINEERING	
QUALIFICATION CODE: 08BMIN	LEVEL: 7
COURSE CODE: DBS721S	COURSE NAME: DRILLING AND BLASTING 323
SESSION: NOV 2022	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 100

SECOND OPPORTUNITY EXAM PAPER	
EXAMINER(S)	Mr L. Madziwa
MODERATOR:	Mr P. Shava

INSTRUCTIONS
1. Answer all questions. 2. Read all the questions carefully before answering. 3. Marks for each questions are indicated at the end of each question. 4. Please ensure that your writing is legible, neat and presentable.

PERMISSIBLE MATERIALS

1. Examination paper.
2. Scientific calculator.

THIS QUESTION PAPER CONSISTS OF 5 PAGES (Including this front page)

Question 1 [13 marks]

In blasting operations, the quantity of explosives used is one of the major factors that control fragmentation size. Differentiate between the following:

i. Low explosive and high explosive [2]

ii. Dry Blasting agent and wet blasting agent [2]

iii. Safety fuse and detonating fuse [2]

iv. Detonation and Deflagration [2]

v. Primary and Secondary blasting [2]

vi. Plaster shooting and Pop shooting [3]

Question 2 [10 marks]

(a) Explain briefly the following properties of explosive:

i. Water resistance [2]

ii. Fumes characteristics [2]

iii. Sensitiveness [2]

iv. Flammability [2]

(b) Explain the role of detonation pressure in rock breakage [2]

Question 3 [17 marks]

a) The specific gravity of commercial product ranges from 0.8 – 1.6. Determine the loading density of an explosive which has a charge diameter of 45mm and a specific gravity of 1.2 [4]

b) In a quarry, rock is extracted with a uniaxial compressive strength of 200MPa, in benches 10m high. Drilling carried out with rotary percussive to hammer rig and a

diameter of 105mm. The explosives used are composed of cartridge slurry of 75mm in diameter and bulk ANFO with respective densities of 1.2 and 0.8g/l. The drilling pattern and charge distribution are to be determined, maintaining the blasthole inclination at 20°. Determine the following parameters, given that Qc =26.57 kg, Qb = 24.63 kg

a. the sub drill (J), [1]
b. blasthole length (L), [4]
c. burden, [1]
d. spacing, [1]
e. volume of broken rock (VR), [2]
f. yield of broken rock (RA), [1]
g. blasthole charge (Q), and [1]
h. the Powder Factor CE. [1]

Question 4 [20 marks]

A new zinc and lead deposit is to be worked by surface mining methods with 12m benches using 250mm diameter blast holes. The prevailing condition is dry rock, it has been decided to use bulk ANFO with emulsion cartridges as primer. Assume that the overall density of compacted ANFO and the primer as 0.85 g/cm^3 and the powder factor of 0.6 kg/m^3. Find the following parameters, by assuming that the drilled blast holes are staggered pattern forming equilateral triangle, Rock Factor (A) = 11, Fly rock must be controlled (Z) = 1.25, The mass of explosive (Q) in 8-hole diameter = 25 kg :

a. Burden [1]
b. Spacing for vertical and inclined holes [1]
c. Optimum Stemming (T) [4]
d. Subdrilling (J) [1]
e. Blasthole length (L) [1]
f. Charge length (Lc) [1]
g. Explosive mass per meter (Qe) [2]
h. Mass of Explosive (Qm) [2]
i. Volume of rock blasted (Vr) [2]
j. Charge length of incline holes 20° [3]
k. Volume of rock blasted (VR) [2]

Question 5 [20 marks]

Given the following information design a blast using the formulae in Surface Blast Design, in a competent dolomite using the following parameters.

- Hole Diameter = 98mm
- Bench height = 15.0 m

- Hole angle = 90^0
- Explosive = Magnum Buster Gel
- Density of magnum cartridge ρ = 1.21kg/m³
- Cartridge diameter = ¾*98
- K_{tech} = 0.45 kg/m³
- Spacing to Burden S = B

The mine is close to a residential area, so fly rock must be controlled. The conditions are dry with little or no water in the holes. Loading equipment in use is front-end loader. Determine the following;

a. Burden, [1]
b. Sub-drill, [2]
c. Stemming height, [2]
d. explosive column, [5]
e. number of cartridges and [5]
f. the powder factor. [5]

Question 6 [15 marks]

The open pit mine has massive fine-grained lava with a skarn gold mineralization. Blast holes drilling is to be carried out in this rock formation with UCS of 200MPa by using two TC inserted tricone bits of 320 mm and 300mm diameter from different manufacturers, with a feed force including the drill head weight of 30 000 kg at a rotary speed of 80 rpm and rock penetration factor of 65.

a. Determine which bit size will yield a faster penetration rate if both bits operate with the same feed force and speed? [5]
b. Calculate the drilling rates for both bit sizes? [5]
c. Draw your conclusion on the answers in (a) and (b)? [5]

Question 7 [5 marks]

An explosive is a material that undergoes rapid exothermic oxidation reaction (combustion), producing immense quantities of gas when it detonates.

a) Calculate the detonation pressure of explosive ANFO if its density is 0.85g/cc and the velocity of detonation is 3000 m/sec. [4]
b) A percussion drill working on a granite bearing uranium mine with a penetrating rate of 50m/h including non-productive times and mechanical availability of the machine which is usually 80%. Calculate the average drilling rate per hour. [1]

End of Examination

Important formulae for DLB 721S – 2022

1. $$K_{act} = \frac{(L + U) * M_c}{B * S * H}$$

2. $$B = 0.012\left(\frac{2SG_E}{SG_R} + 1.5\right) \times D_E$$

3. $$M_c = \frac{C}{100} * \frac{\rho * d^2}{1273}$$

4. $$B = \sqrt{\frac{LM_c}{aHK_{tech}}}$$

5. $$V = \frac{\pi D^2}{4} xRD$$

6. $$Q = \frac{\pi}{4}\frac{d}{1000}\rho$$

7. $P = 5.7 \times 10^{-5} \times (RF - 28 \times \log(0.145 \times S_c))\ W/\emptyset \times RPM$

7.a. $$P = (61 - 28\log_{10} S_c)\frac{W}{\phi} \bullet \frac{rpm}{300}$$

$Um = 264p^{½}d^{½}$

Where: d = diameter of the chip in inches
p = density of chip in Ib/ft3

8.

9. $$VM = 2 * VP^{0.65} = 2 * 50^{0.65} =$$

10. RDI = 25*RD-50=25*2.8-50 = 20

11. HF = UCS /5 =500/5=100

12. Rock Factor (A) = 0.06(RMD+JF+RDI+HF) =0.06(50+ 20+100) =10.2

13. $P = 2.5 \times \rho v^2 \times 10^{-6}$