EXAMINATION PAPER

SUBJECT:	**EXAMINER:**
CHAMBER OF MINES OF SOUTH AFRICA CERTIFICATE IN ROCK MECHANICS PAPER 3.1 (HARD ROCK TABULAR) **SUBJECT CODE:** COMRME **EXAMINATION DATE:** OCTOBER 2007	Mr. T RANGASAMY **MODERATOR:** Dr. T HAGAN **TOTAL MARKS:** [100] **PASS MARK:** 60%

NUMBER OF PAGES: 6

SPECIAL REQUIREMENTS:

1. **Answer *ALL FOUR* questions**
2. References other than those provided are not permitted.
3. Hand-held electronic calculators may be used.
4. Put your examination number on the outside cover of each book used and on any graph paper or other loose sheets handed in.

NB: your name must not appear on any answer book or loose sheets.

5. **Write in ink on the RIGHT HAND SIDE of the paper only (only the right hand pages will be marked).**
6. Show all calculations on which your answers are based.
7. Illustrate your answers by sketches or diagrams wherever possible.
8. In answering these questions, full advantage should be taken of your practical experience, where appropriate.
9. Answers must be given to an accuracy that is typical of practical conditions, unless stated otherwise.

CERT. IN ROCK MECHANICS: PAPER 3.1

HARD ROCK TABULAR

QUESTION 1

Rock mass ratings were obtained for the UG2 orebody from drill core for a greenfields project in a platiniferous mine located in the South African Bushveld Complex. The final operating depth of the mine is estimated at 600 metres below surface. Stress measurements indicate a k-ratio of 1.5 throughout the orebody. The seam height and orebody dip are 1.2m and 10 degrees, respectively. The overburden density is 3 tons/m^3.

Classification	Mean	Standard deviation
RMR	66.22	11.07
Q	2.80	1.74
MRMR	53.05	3.91

1.1 Describe the parameters used to determine ratings for each of the classification schemes listed in the above table **(10)**

1.2 Uniaxial compressive strength tests have indicated mean orebody strengths of 87 MPa. Determine the mean, minimum and maximum design rock mass strength (DRMS) using the following formula and accompanying UCS rating table: **(3)**

$$DRMS = UCS \times (MRMR - R_{UCS})/100$$

UCS (MPa)	164-145	144-125	124-105	104-85	84-65	44-25	24-5	4-0
Rating	14	12	10	8	6	4	2	0

3.0. Using the approach adopted by Hedley and Grant and assuming Tributary Area Loading,

1.3.1 Calculate the strength of a 5m wide square pillar **(2)**

1.3.2 Calculate the FOS of the above pillar for the maximum depth of the operation assuming bord and pillar workings with bord widths of 6m. **(3)**

1.4 If the relationship between RMR and Q is governed by the following empirical relationship: RMR = 9 ln Q + 44, provide comment on the appropriateness of this relationship for measured RMR and MRMR results **(2)**

(20 marks)

QUESTION 2

An isolated block of ground containing 5000 m^2 of Carbon Leader Reef is planned for extraction between two sub-parallel dip trending faults spaced 100m apart at approximately 2500 mbs. Seismic polygons using a 10 year catalogue of events indicates a maximum possible event size of M_L = 3.2. Prior to implementing an extraction programme, the mines Code of Practice requires a rock related risk assessment to be performed, formally drafted and incorporated into the mine design.

Provide a single tabulation describing the:

2.1 Rock related hazards
2.2 Rock engineering/seismic methods used to quantify risks
2.2 Measures to mitigate/manage/eliminate risks

(20 marks)

QUESTION 3

CERT. IN ROCK MECHANICS: PAPER 3.1

HARD ROCK TABULAR

Excavation support design follows a logical design process which includes, but is not exhaustive to, gaining knowledge and understanding of:

- The geotechnical parameters that influence stability,
- The factors that govern stability (panel and regional scale)
- The rock engineering/seismic techniques that will be applied to assess stability
- The quality assurance and quality control measures that need to be implemented to ensure that actual performance mimics designed performance

List and describe the role of each of the above for the following geotechnical environments:

3.1 A chrome mine mining the LG6/6a in the Bushveld Complex **(10)**

3.2 A platinum mine undermining the Merensky Reef in pothole reef facies **(10)**

3.3 A gold mine mining the Basal Reef at 2400 mbs **(10)**

3.4 Sections of a shaft barrel intersecting the VCR at 2000 mbs **(10)**

(40 marks)

QUESTION 4

HARD ROCK TABULAR

Numerical modelling if used appropriately is an important tool for Rock Engineering design. Describe the numerical modelling programmes or combinations you would use, the input parameters and results you will analyse to determine each of the following:

4.1. The width and spacing of regional dip stabilising pillars in a deep gold mine **(5)**

4.2. The dimensions of rigid pillars in a platinum mine that uses conventional hand-held drilling and blasting techniques with scraper cleaning **(3)**

4.3. The location of a decline cluster below the UG2 seam in rock mass with a mean RMR = 42 **(6)**

4.4. The thickness of a crown pillar between the base of the openpit and the start of underground UG2 extraction **(6)**

(20 marks)