Fayoum University
Faculty of Engineering
Department of Civil Engineering

Final Exam (1 st Year Civil)
Engineering Geology

Date: Tuesday 12 Jan 2016 Time: 09:30am – 12:30pm
Total Grade: 70 Points Instructor: Dr. Mohamed Hussien

Notes: 1. **No aids other than calculators.**
2. **Start each question in a new page.**

السؤال الاول:- أكمل الجمل الاتية (Geology of Rocks / 10 points)

1- البيروكسين و الامفيبول من السليكات .....
2- الريولايت يعتبر من الصخور .....
3- يعتبر الاوبسيديان من الصخور النارية ذات النسيج .....
4- يعتبر حجر الجبس من الصخور .....
5- الكعكة الصفراء من اهم مراحل .....
6- حصوات الكلى تعتبر مثال بسيط على تكوين الصخور.....
7- من معادن الكبريتيدات .....
8- الحجر الرملي يعتبر من الصخور .....
9- ..... هو لون مسحوق المعدن الناعم.
10- السليكات تعتبر من المعادن الاساسية في تركيب الصخور .....

Question No.2 (State if the following is correct or false) (Mechanics of Rocks / 10 points)

1- By decreasing the RMR value, the GSI value will increase.
2- The value of ''a'' in GHB equation is not equals to one in intact rock.
3- The geological strength index (GSI) equals to 100 in case of very weak rock.
4- The value of ''s'' in GHB equals to zero in intact rock.
5- The condition of discontinuities has a minor rate on RMR (basic).
6- The orientation of discontinuities does not effect on the RMR.
7- The rock with RQD = 30 % can be described as a fair rock.
8- Uniaxial compressive strength (USC) can be estimated based on the point load test.
9- By increasing the RMR value, the safe cut slope angle will increase.
10- By increasing the RMR value, the shear strength parameters will decrease.

Question No. 3 (20 points)

a) Derive a relationship between principal stresses and shear strength parameters based on MC?

b) A direct shear box test has been conducted on a sedimentary rock, the following equation can represent the results obtained from this test.

$$\tau = 300 + \sigma \tan 35$$

Based on the previous equation estimate the following: (Note:- stress units in kPa)

1- Shear strength parameters using MC.

2- Find a factor of safety for point has normal stress 100 kPa and shear stress 250 kPa.

3- Using the regression analysis to estimate (UCS and m_i), at normal stresses (σ) [50 kPa, 100 kPa, 150 kPa and 200 kPa]

Question No. 4 (15 points)

a) Find the shear strength parameters can be deduced from each of the following data in the case of tunnel (depth of tunnel underground = 35 m, rock unit weight = 22 kN/m^3)

1) UCS = 15000 kPa GSI = 55 mi = 8 D = 1

2) UCS = 15000 kPa GSI = 55 mi = 8 D = 0

b) Uniaxial compression test has been implemented on a lime stone intact rock, the following data were collected (Sample height = 8 cm, sample diameter = 4 cm).

Load (ton)	0	0.25	0.65	1.35	1.45	1.64	1.15	0.92
Dial reading (mm)	20.00	19.87	19.66	19.47	19.20	18.89	17.00	16.50

Find the following:-

1- The uniaxial compressive strength for the tested specimen and point load strength index?

2- If a sample from the same rock is tested in triaxial apparatus failed at principal stresses (50 kg/cm^2 and 250 kg/cm^2), Find the shear strength parameters?

3- The uniaxial compressive strength for a rock mass if the geological strength index for this rock equals 65?

Question No. 5 (15 points)

a) Explain in short each of the following:-

1-SPT 2-GPR 3-MASW

b) Find relationships between each of the compressional wave velocity and the shear wave velocity in terms of Elastic modulus, Passion's ratio and mass density.

c) State and draw the types of faults.

With all best wishes Dr. Mohammed Hussien - Fayoum in 12-1-2016

Appendix

$$\sigma_1' = \sigma_3' + \sigma_{ci}\left(m_b\frac{\sigma_3'}{\sigma_{ci}} + s\right)^a \qquad m_b = m_i \exp\left(\frac{GSI-100}{28-14D}\right)$$

$$s = \exp\left(\frac{GSI-100}{9-3D}\right) \qquad a = \frac{1}{2} + \frac{1}{6}\left(e^{-GSI/15} - e^{-20/3}\right)$$

$$\sigma_{ci}^2 = \frac{\sum y}{n} - \left[\frac{\sum xy - (\sum x \sum y/n)}{\sum x^2 - ((\sum x)^2/n)}\right]\frac{\sum x}{n} \qquad m_i = \frac{1}{\sigma_{ci}}\left[\frac{\sum xy - (\sum x \sum y/n)}{\sum x^2 - ((\sum x)^2/n)}\right]$$

$$\phi' = \sin^{-1}\left[\frac{6am_b(s+m_b\sigma_{3n}')^{a-1}}{2(1+a)(2+a)+6am_b(s+m_b\sigma_{3n}')^{a-1}}\right]$$

$$c' = \frac{\sigma_{ci}\left[(1+2a)s+(1-a)m_b\sigma_{3n}'\right](s+m_b\sigma_{3n}')^{a-1}}{(1+a)(2+a)\sqrt{1+\left(6am_b(s+m_b\sigma_{3n}')^{a-1}\right)/((1+a)(2+a))}}$$

where $\sigma_{3n} = \sigma_{3\max}'/\sigma_{ci}$

for tunnels

$$\frac{\sigma_{3\max}'}{\sigma_{cm}'} = 0.47\left(\frac{\sigma_{cm}'}{\gamma H}\right)^{-0.94}$$

$$\sigma_{cm}' = \sigma_{ci}\cdot\frac{(m_b+4s-a(m_b-8s))(m_b/4+s)^{a-1}}{2(1+a)(2+a)}$$