00179

THE OPENUNIVERSITY OF SRI LANKA
Department of Civil Engineering
Bachelor of Technology (Civil) - Level 5

CEX5232 – Engineering Geology

FINAL EXAMINATION – 2016/2017

Time Allowed: Three (03) Hours

Date: 09-11-2017 (Thursday) Time: 0930- 1230 hrs.

Answer five (5) out of eight (8) questions.

Q1. Rocks are composed of minerals and are having wide variety of textures.

(a). Define and describe what is a **Mineral** ? (8 marks)

(b). How to you broadly classify Minerals into groups and provide at least three (03) examples for each group. (6 marks)

(c). Write down a short account on " applications of minerals" in the industry. (6 marks)

Q2. Understanding on "Plate Tectonics" of the Earth's crust is essential for engineering geologists.

(a). State and describe **three** evidences that support "Plate Tectonic Theory". (6 marks)

(b). Describe what is meant by Divergent Boundaries. (5 marks)

(c). State and describe **three** types of Convergent Boundaries that exists on Earth's crust. (9 marks)

Q3. Write Short Notes on Following.

(a). Folds. (5 marks)

(b). Physical weathering. (5 marks)

(c). Talus and Screes. (5 marks)

(d) Volcanoes (5 marks)

(e) Sedimentary rock aquifers (5 marks)

Q4. The information shown in Table Q4 (1) were reported during a site investigation program for a cut slope area in a road construction project.

Table Q4 (1)

Item No.	Rock Mass Parameter Description		Rock Mass Parameter
01	Drill quality of rock mass		Core Recovery= 100% Rock Quality Designation= 80% Fracture Index= 4/m
02	Discontinuity spacing		3.50 m
03	Discontinuity condition	Length	4.60 m
		Separation	0.45 mm
		Roughness	Slightly rough
		Infilling	Soft filling<5 mm
		Weathering	Slightly weathered
04	Groundwater condition		Completely dry
05	Average Uniaxial Compressive Strength of rock cores		358 MPa

Furthermore;

Below given Figure Q4 (1) shows the cross section of the proposed road cut and joint pattern characteristics with respect to slope geometry these join sets and road trace plane are striking perpendicular to the cross section.

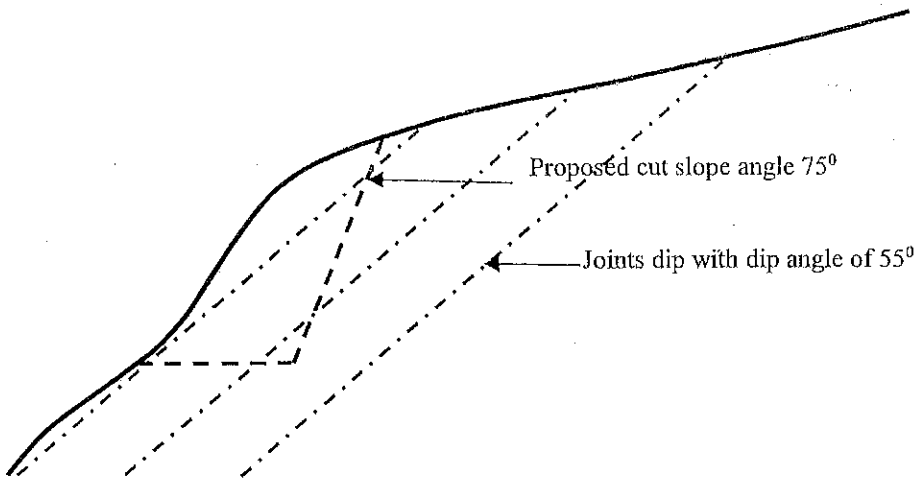

Figure Q4 (1)

With the above given information in Table Q4 (1), Figure Q4 (1) and with the help of attached Table Q4 (2) to Table Q4 (8), answer following questions.

(a). Determine the Rock Mass Rating (RMR) value of the rock mass for the particular section of the road cut slope. (8 marks)

(b) Determine the Adjusted Rock Mass Rating (RMR) value of the rock mass for the particular section of the road cut slope, based on the discontinuity orientation. (7 marks)

(b). Propose range of values to **angle of internal friction** and **cohesion** to the given rock mass. (5 marks)

Q5. Four tube wells TW- 01, TW- 02, TW- 03 and TW- 04 have been carried out to extract groundwater in a region, which include two rivers and the tube well positions and the subsurface cross section of the particular region is shown in Figure Q5 (1).

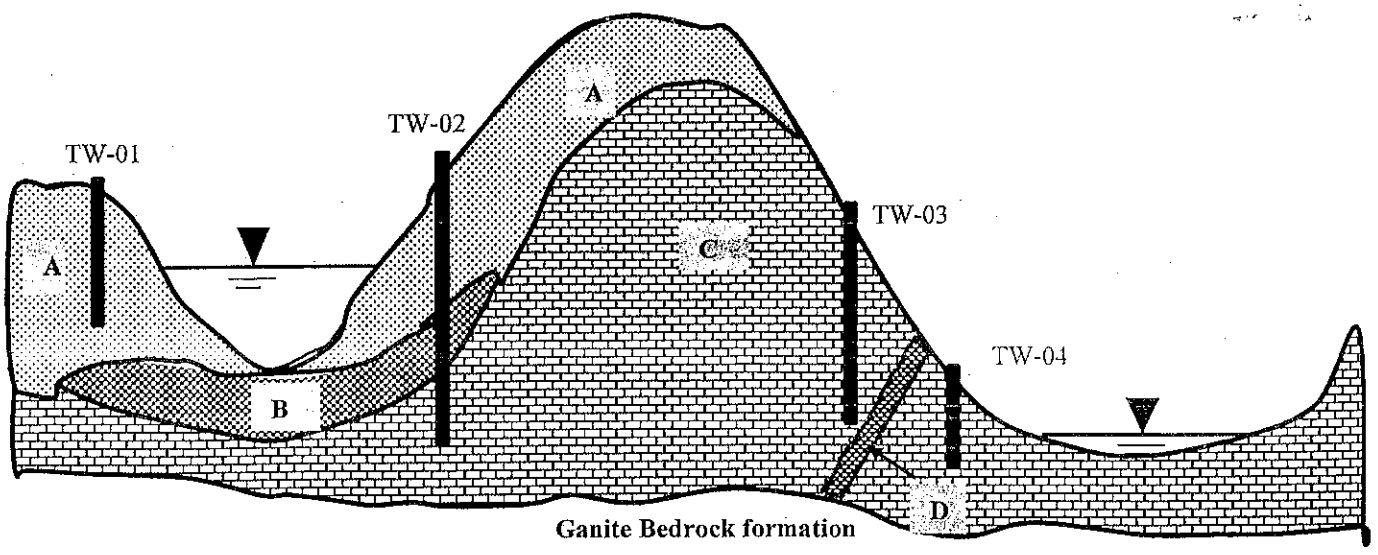

Figure Q5 (1)

Legend:

A- Silty coarse sand, B- Shale, C- Karstified Limestone, D- Quartzite Dyke

(a) Define what is an aquifer? (4 marks)

(b) Assuming that the tube wells are sealed down to the bottom, write down the type of aquifer from which each tube well that extract the groundwater. (8 marks)

(c). Assuming the same conditions in (b) and in a condtion where pumping of water from each tube well is not carried out, draw the approximate phreatic line which connects the water levels of each tube well. (8 marks)

Q6. River banks and beds erosion is a major environmental problem currently faced by Sri Lankan river systems.

a) Write down three (03) factors, which affect the river bed erosion rate. (6 marks)

b) Describe about three (03) "depositional features" that can be commonly observed in relation to river flow. (9 marks)

c) Write down five (05) counter measures that can be adopted against surface erosion. (5 marks)

Q7. A rock slope has been created due to an excavation for a road cut to a height of 15 m at a face angle of 60^0. The rock mass which this cut has been made contains a **very weak clay band** which dips at an angle of 20^0 and dips towards the slope face and strikes parallel to it. During a rainy season, a tension crack has been created exactly on the crest of the slope and is filled with water to its full height above the weak clay band (i.e possible sliding surface). The strength parameters of sliding surface are; cohesion (c) =20 kPa and angle of internal friction (ø) = 20^0. The unit weight of rock mass material is 26 kN/m^3 and the unit weight of water can be assumed as 9.81 kN/m^3.

(a). Draw a labelled diagram showing all the slope geometrical parameters pertaining to above mentioned information. (2 marks)

(b). Mark all the forces affecting the stability of the slope concerned in the same diagram drawn in Q(7)(a) (3 marks)

(c). Calculate the factor of safety of the slope under above mentioned conditions. (8 marks)

(d). Estimate the total tensile force that will be required to provide to improve the factor of safety of this slope to a value of **02** using Anchor Bolts installed perpendicular to weak clay band. (7 marks)

Q8. Suppose you have been appointed as the geotechnical engineer responsible for geotechnical investigations program for a retaining wall construction.

(a). Write down the basic geotechnical parameters that you will need to obtain from this investigation programme in order to design a safe and economical structure with reasons. (6 marks)

(b). Develop a subsurface exploratory drilling program that should be performed to obtain the geotechnical parameters mentioned in Q8 (a). In your answer following aspects should be clearly mentioned.

(i) Drilling methodology and frequency of exploratory locations

(ii) In-situ tests that will need to be performed with reasons for performing the test.

(iii) Depth of exploration. (iv) Methods of sampling. (8 marks)

(c). Formulate a laboratory testing program that should be performed for the same site with reasoning. (6 marks)