



UNIVERSITY OF RUHUNA

Faculty of Engineering

Mid-Semester 4 Examination in Engineering: November 2014

Module Number: CE4311 Module Name: Engineering Geology and Soil Mechanics

[Two Hours]

[Answer all questions, each question carries five marks]

Q1. Answer the following questions using the geological map shown in Figure Q1.

- Draw the structure contours for the given geological map. [0.5 Marks]
- Deduce the dip angle and strike of the sandstone. [0.5 Marks]
- Draw the geological cross-section along AB line on a graph sheet by indicating the vertical exaggeration [2.0 Marks]
- Calculate the thickness of the upper sandstone layer [2.0 Marks]

(Note: The geological map and the geological cross-section should be attached to the answer book)

Q2. Answer the following question briefly

- What is the accepted theory to explain the origin of the Universe?
- What is a singularity?
- What are the evidences to prove the accepted theory of origin of Universe?
- Briefly explain the formation of solar system?
- What are the stars?

[1.0 Marks x 5 = 5.0 Marks]

Q3. a) Draw a phase diagram and derive the following relationships for a partially saturated soil.

- $$e = \frac{wG_s}{S}$$
- $$\gamma = \frac{S(1+w)G_s\gamma_w}{(S+wG_s)}$$
- $$\gamma_d = (1-A) \frac{G_s\gamma_w}{1+wG_s}$$
- $$A = n(1 - S_r)$$

[2.5 Marks]

- A partially saturated soil sample has a moisture content of 20 % and bulk density of 2000 kg/m³.
 - If the specific gravity of soil particle is 2.65, calculate the degree of saturation and the void ratio.
 - Calculate the saturated density of the soil.

iii) Calculate the dry density and the air content of the soil.

[2.5 Marks]

Q4. a) Write short notes on;

- i) Stoke's law
- ii) Meniscus correction
- iii) Dispersing agent correction

[1.5 Marks]

b) Explain in detail the use of the Plasticity Chart in defining a soil (A Unified Soil Classification Chart (Table Q4.1) and a Plasticity chart (Figure Q4) are provided for reference, if necessary).

[1.0 Mark]

c) The results of sieve analysis and hydrometer analysis of a soil are shown in Table Q4.2. The fine fraction of soil has a Liquid Limit of 26 and Plastic Limit of 17. Plot the particle size distribution of this soil sample and classify the soil according to the Unified Soil Classification System.

Note:- Particle size distribution, can be drawn in semi-log graph sheet provided and should be attached to the answer book.

[2.5 Marks]

Table Q4.2 Sieve analysis test data

Particle size (mm)	Mass of soil retained (g)
50	15.40
20	52.36
9.5	27.72
6.75	9.24
4.75	9.24
2.36	9.24
1.18	9.24
0.60	12.32
0.30	12.32
0.21	9.24
0.15	9.24
0.075	18.48
0.02	46.20
0.006	24.64
0.002	18.48
< 0.002	24.64

Table Q4.1 Unified Soil Classification Chart

Description			Group symbol	Laboratory criteria			
				Fines (%)	Grading	Plasticity	Notes
Coarse grained {more than 50% larger than 63 μm BS or No. 200 US sieve size} > 0.075 mm	Gravels {more than 50% of coarse fraction of gravel size} > 4.75 mm	Well graded gravels, sandy gravels, with little or no fines	GW	0 - 5	$C_u > 4$ $1 < C_c < 3$		Dual symbols. If 5 - 12 % fines. Dual symbols if above A-line and $4 < PI < 7$
		Poorly graded gravels, sandy gravels, with little or no fines	GP	0 - 5	Not satisfying GW requirements		
		Silty gravels, silty sandy gravels	GM	> 12		Below A-line or $PI < 4$	
		Clayey gravels, clayey sandy gravels	GC	> 12		Above A-line and $PI > 7$	
	Sands {more than 50% of coarse fraction of sand size}	Well graded sands, gravelly sands, with little or no fines	SW	0 - 5	$C_u > 6$ $1 < C_c < 3$		
		Poorly graded sands, gravelly sands, with little or no fines	SP	0 - 5	Not satisfying SW requirements		
		4.75 - 0.075 mm	Silty sands	SM	> 12		
	Clayey sands		SC	> 12		Above A-line and $PI > 7$	

Fine grained {more than 50% smaller than 63 μm BS or No. 200 US sieve size} < 0.075 mm	Silts and Clays {Liquid Limit less than 50}	Inorganic silts, silty or clayey fine sands, with slight plasticity	ML	Use plasticity chart
		Inorganic clays, silty clays, sandy clays of low plasticity	CL	Use plasticity chart
		Organic silts and organic silty clays of low plasticity	OL	Use plasticity chart
	Silts and Clays {Liquid Limit greater than 50}	Inorganic silts of high plasticity	MH	Use plasticity chart
		Inorganic clays of high plasticity	CH	Use plasticity chart
		Organic clays of high plasticity	OH	Use plasticity chart
Highly organic soils		Peat and other highly organic soils	Pt	

Primary letter		Secondary letter	
G	Gravel	W	Well graded
S	Sand	P	Poorly graded
M	Silt	M	With non-plastic fines
C	Clay	C	With plastic fines
O	Organic soil	L	Of low plasticity (LL < 50)
Pt	Peat	H	Of high plasticity (LL > 50)

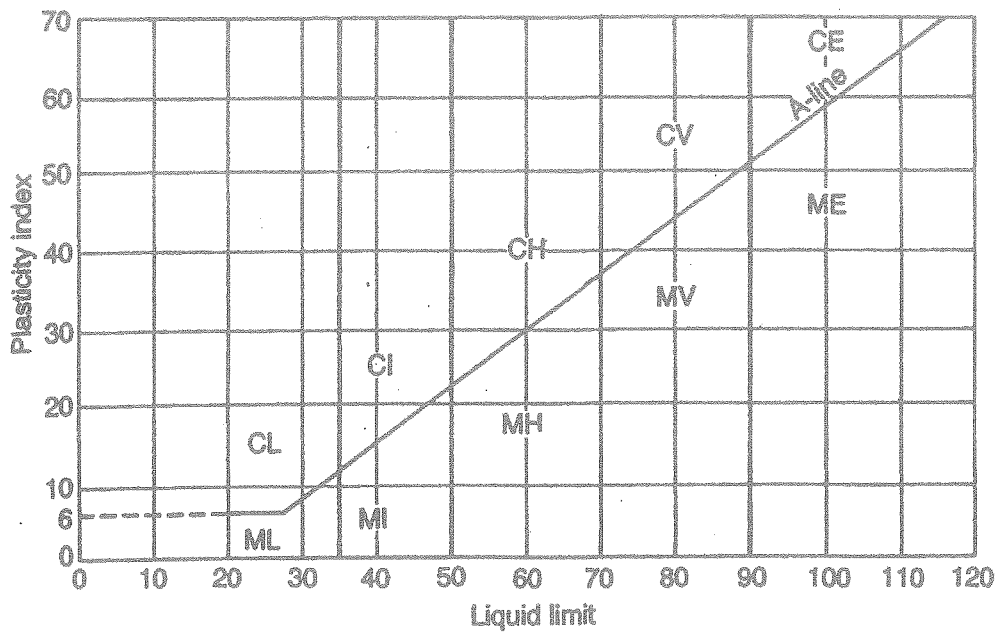
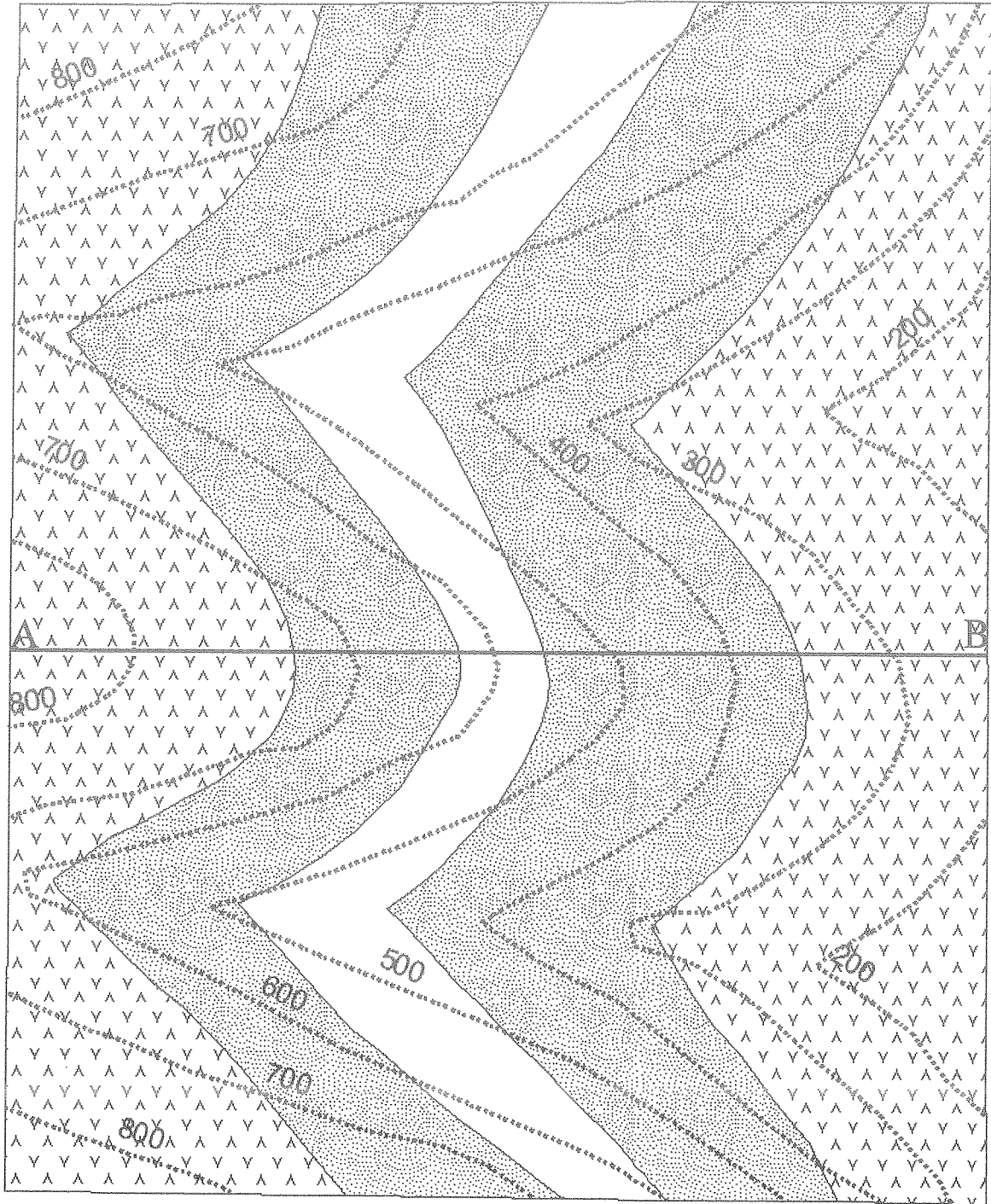
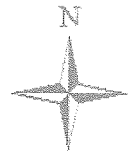


Figure Q4 - Plasticity Chart

Geology Map



- | | |
|-----------------|-----------------|
| MUDATONE | UPPER SANDSTONE |
| LOWER SANDSTONE | UPPER SHALE |
| LOWER SHALE | |

Figure Q1 – Geological Map

