TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT BUILDING AND CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:

BSC IN CIVIL ENGINEERING

ECE 2303: SOIL MECHANICS I

END OF SEMESTER EXAMINATION

SERIES: APRIL 2016

TIME: 2HOURS

DATE: 10May2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, Drawing Instruments, Scientific calculator, examination pass and student ID

This paper consists of five questions. Attemptquestion ONE (Compulsory) and any other TWO questions.

QUESTION ONE (COMPULSORY)

(a) (i) Briefly explain the term 'liquefaction' as applied in construction.

(ii) Outline negative construction effects that are likely to affect housing units constructed on a site that consists of very clayey SILT.

(6 marks)

(b) A student tests oven dried sand samples and finds particle specific gravity and porosity to be 2.69 and 39.7% respectively. Determine;

(i) Submerged density,

(ii) Critical hydraulic gradient.

(iii) Dry density (6 marks)

(c) Explain the following terms:

(i) 'Uniformity coefficient' as applied to soil classification,

(ii) 'Zero air voids maximum dry density' as applied in soil compaction.

(6 marks)

(d) Briefly explain the following as applied to seepage:

(i) Radial flow,

(ii) Boundary conditions for a flownet**.** (6 marks)

(e) Use results for particle size distribution analysis as shown in **figure 1**to answer the following:

(i) Describe the soils tested

(ii) Identify the soil that is susceptible to liquefaction and state possible reason.

(iii) Identify the soil that is more suitable for roadwork and state reasons.

(6 marks)

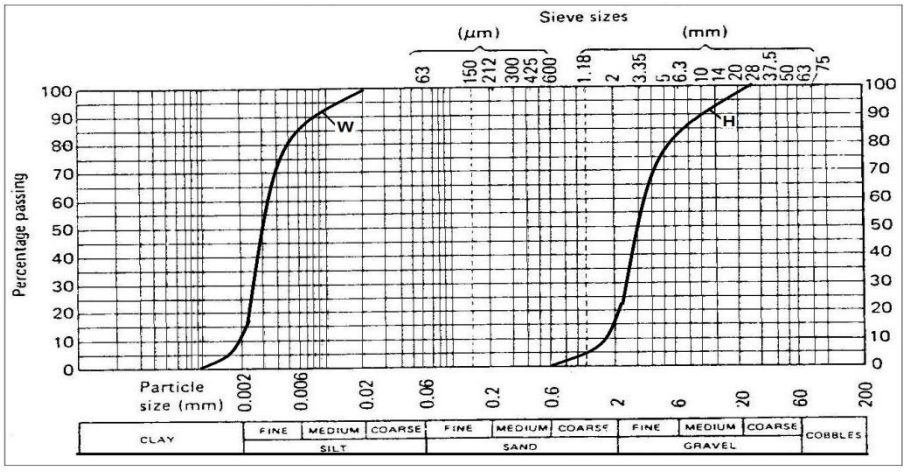

Fig.1

QUESTION TWO

(a) Briefly explain the following terms:

(i) TWO aspects of British soil classification system

(ii) Role of Plasticity index in classification of soils (6 marks)

(b) Liquid limit and plastic limit for an organic soil were found to be 52% and 26% respectively. Results of particle size distribution investigation were carried out on a 340.2 g sample obtained from same site were;

Particle size (mm)	50	37.5	20	14	10	6.3	5	3.35
Mass retained (g)	0	15.5	17	10	11	33	33.5	81

Particle size (mm)	2.0	1.18	0.425	0.212	0.150	0.063	0.01
Mass retained (g)	18	31	32.5	9	8	5.5	5

(i) Use the data and chart provided (Fig.2) to draw grading curve

(ii) Describe the soil.

(iii) Using figure 3 classify the soil. (14 marks)

To be handed in together with the answer booklet

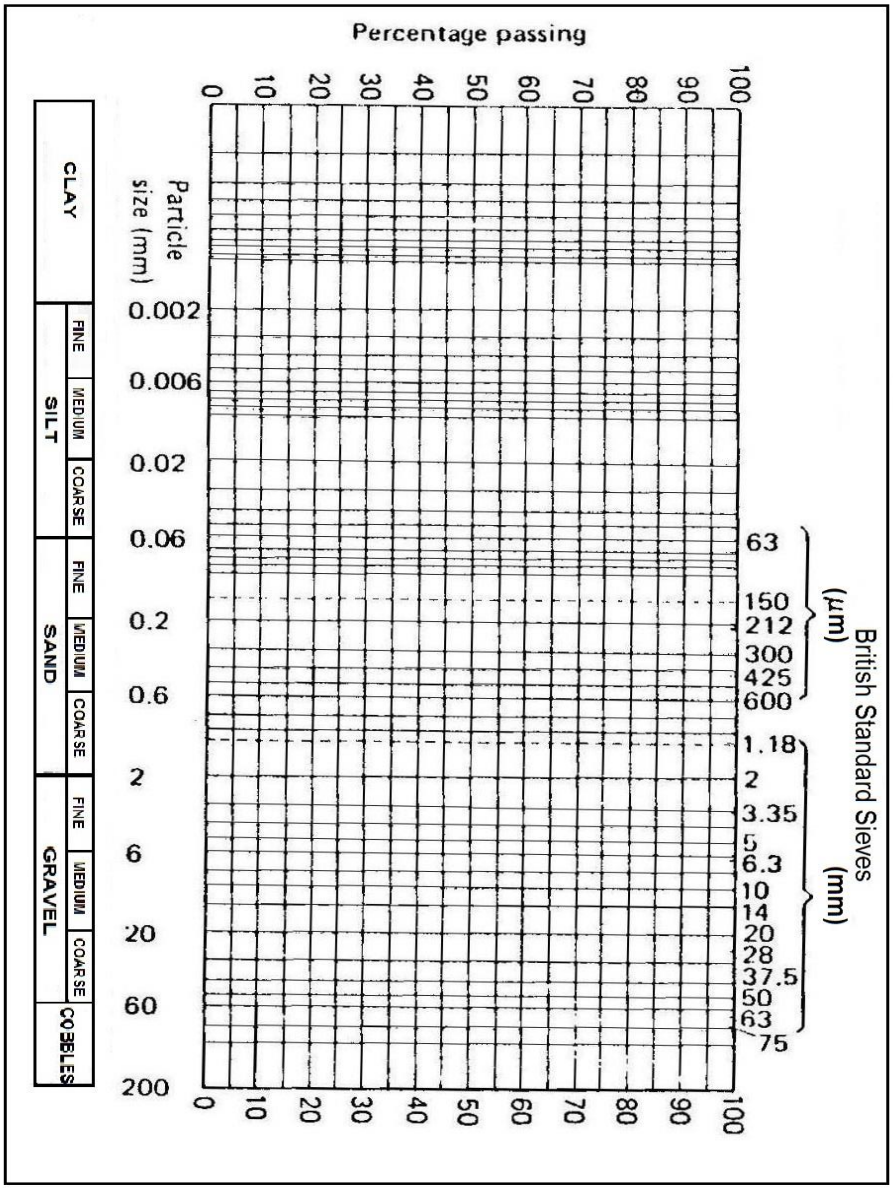

Fig.2

Detach along this line

The British Soil Classification System (Extract)

Description of typical soils	Sub-group Symbol	L.L (%)
Slightly Silty Or Clayey GRAVEL	GW GP GP_U GP_g	
Silty GRAVEL	GWM GPM	
Clayey GRAVEL	GWC GPC	
Very Silty GRAVEL Very clayey GRAVEL	GML etc GCL GCI GCH GCV GCE	 <35 35-50 50-70 70-90 >90
Slightly silty Or Clayey SAND	SW SP SP_U SP_g	
Silty SAND Clayey SAND	SWM SPM SWC SPC	
Very silty SAND Very clayey SAND	SML etc SCL SCI SCH SCV SCE	 <35 35-50 50-70 70-90 >90
Gravelly SILT Gravelly CLAY	MLG etc CLG CIG CHG CVG CEG	 <35 35-50 50-70 70-90 >90
Sandy SILT Sandy CLAY SILT (M-soil) CLAY	MLS etc CLAY etc ML etc CL CI CH CV CE	 <35 35-50 50-70 70-90 >90
ORGANIC SOILS	Descriptive letter 'O' suffixed to any Group or Sub-group symbol	
PEAT	Pt	

PLASTICITY CHART

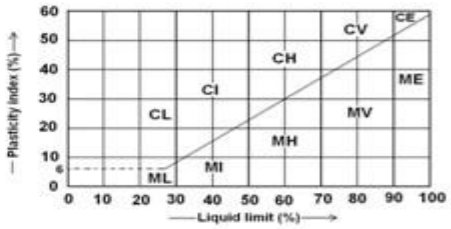

Fig.3

QUESTION THREE

a) State **THREE** possible causes of errors in soil compaction methods. (3 marks)

b) Outline **THREE** main objectives of compacting soils. (6 marks)

c) Proctor method of test was carried out on a soil sample of specific gravity2.68 and the following results were obtained;

Test number	1	2	3	4	5
Mass of compacted soil (g)	2005	2087	2110	2100	2055
Moisture content (%)	12.8	14.5	15.6	16.8	19.2

Volume for the mould used in the compaction was 1000cm^3.

(i) Draw a compaction graph
(ii) Determine compaction parameters
(iii) Determine the following, at the compaction parameters obtained in c (ii)
- Air voids ratio
- Moisture content if the compacted soil is to be within a lower limit of 95% of maximum dry density. (11 marks)

QUESTION FOUR

a) A student compacted first three soil tests using 2.5 kg rammer. A 4.5 kg rammer was then used for the last 3 tests. Explain possible effect that the change could cause.

(3marks)

b) Compare results expected in compaction of sandy GRAVEL and clayey SILT done under same conditions if plotted on same axes. (3marks)

c) Outline **FOUR** main factors that affect soil permeability (8 marks)

d) A silt soil sample was tested in the laboratory in 2 stages. In stage 1 the following results were obtained:

Diameter of stand pipe used (mm)	12
Diameter of test sample (mm)	60
Length of the test sample (mm)	48
Initial water level in stand pipe (mm)	1200
Final water level in stand pipe (mm)	800
Time taken for the water level to decrease	3 min and 20sec.

(i) Determine coefficient of permeability for the soil

(ii) In stage 2 of the test, the soil sample was reduced to $\frac{3}{4}$ of the original length. Another soil sample of permeability 7.5×10^{-3} mm/s was then added to it and the experiment repeated. Determine the expected permeability for combined layers considering;

- Vertical flow direction . Horizontal flow direction (6 marks)

QUESTION FIVE

(a) Explain the term ’Boiling” as applied to seepage (3marks)

(b) A layer of fine soil 15m thick is underlain by an impervious stratum. The layer was subjected to a pumping test. Water level decreased by 8m in the pumped well and 1.5m in an observation well situated 20m away from the pumped well. Diameter for the pumped well was 200mm and a pumping rate of 2.2 m^3/hr was maintained during the test. If ground water level was initially located 1m from the surface, calculate coefficient of permeability for the soil layer. (4 marks)

(c) A soil deposit of a construction site shown in figure 4 has particle specific gravity and porosity of 2.70 and 0.38 respectively. Determine the following:

(i) Critical hydraulic gradient for the soil.

(ii) Quantity of seepage if the structure is 7m wide. (Take K = 4.65 x10^{-5}m/s)

(iii) Seepage pressure for shaded soil column.

(iv) Possibility of piping occurring at point marked A.

(v) Height to which water would rise in a stand pipe installed to point ‘W’

(13 marks)

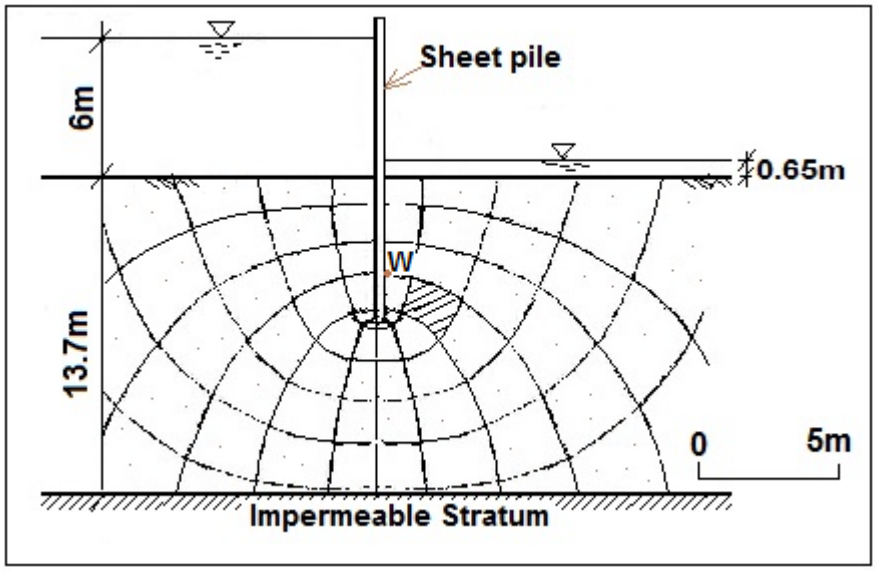

Fig. 4