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) Briefly explain the following as applied to soils

- **(i)** 'Granular soil'
- **(ii)** 'Air voids ratio'
- **(iii)** Significance of plasticity index
- **(iv)** 'Hydraulic conductivity'
- **(v)** 'Flow lines'

(10marks)

(b) A saturated soil sample was tested in the laboratory. The saturated density and moisture content of the soil were 2.049 g/cm^3 and 22.75% respectively. Determine;

(i) Dry density **(ii)** Void ratio **(iii)** Specific gravity of the particles **(iv)** Critical hydraulic gradient

(10 marks)

(c) The following results were obtained from a liquid limit test on an organic a soil of plastic limit 23%:

Number of blows	**17**	**30**	**40**
Mass of wet soil +container (g)	22.9	21.7	18.5
Mass of dry soil +container (g)	17.9	17.7	15.7
Mass of container	8.3	8.3	8.3

(i) Use the results and figure 1 to determine the liquid limit,

(ii) Describe the soil,

(iii) Using the results and figure 2, classify the soil tested,

(iv) The soil is to be used in roadwork, propose mitigation measure for approval of use of the soil for the roadwork. **(10marks)**

To be handed in together with the Answer Booklet

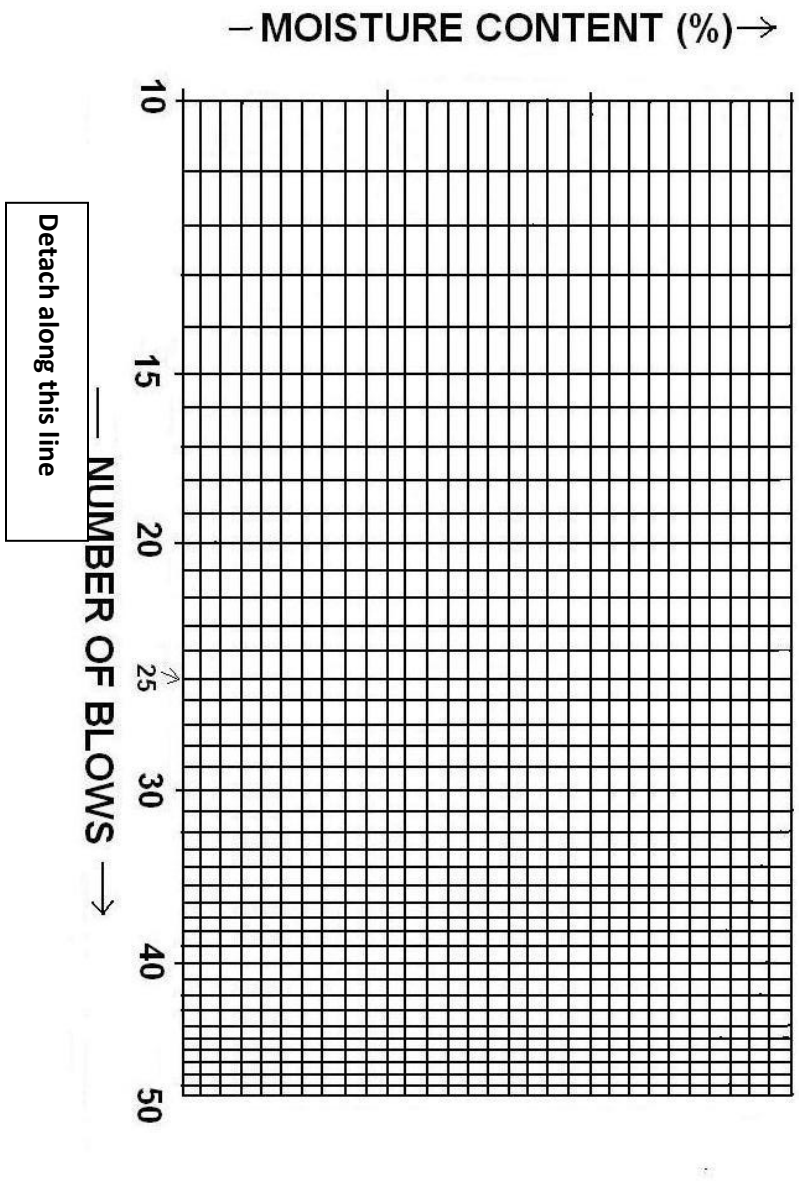
MOISTURE CONTENT (%)
NUMBER OF BLOWS
10
15
20
25
30
40
50
Detach along this line

FiG. 1

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

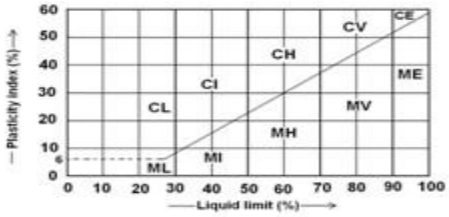

Fig.2

QUESTION TWO

(a) Distinquish a sandy SILT from a clayey SILT based on toughness is the two soils occur on a site. (4 marks)

(b) Briefly explain the effect of the following in construction material used for roadworks:

(i) Particle rounding,

(ii) Platy particle shape. (4marks)

(c) Particle size distribution of a soil was investigated using the dry sieving and sedimentation methods. The results obtained were as follows:

Dry sieving	**Sieve size (mm)**	0.60	0.212	0.063	
	Mass retained (g)	7.42	22.80	44.18	
Sedimentation	**Particle size (mm)**	≤ 0.06	≤ 0.02	≤ 0.006	≥ 0.002
	Mass of particles(g)	37.49	21.83	7.02	2.70

(i) Compute the data for particle size distribution analysis,

(ii) Use the computed results to draw a grading curve on figure 3,

(iii) Describe the soil,

(iv) Classify the soil using figure 2. **(12 marks)**

QUESTION THREE

(a) Outline **FOUR** factors that affect permeability **(8 marks)**

(b) A permeameter of diameter 75 mm contains a column of fine sand 500mm long. Water is passed through the sand at a rate of 200.5 ml/min. under a constant head. (i)
(i) Determine the loss of head between two points 300 mm a part. Take k = 0.42 mm/s.
(ii) If a falling head were to be performed on the sample in (i), determine the diameter of the standpipe required for the water level to fall in 1 minute from an initial of 1300 mm to a final level of 800 mm. **(4 marks)**

(c) An unconfined aquifer 25m thick has ground water at a level of 1m below the ground surface. During a pumping test, the water level falls by 10m in the pumped well and 1.5m in an observation well situated 20m away from the pumped well. Diameter for the pumped well is 200mm and a pumping rate of 2.0 m^3/hr is maintained during the test. Calculate coefficient of permeability for the aquifer. **(8 marks)**

To be handed in together with the answer booklet

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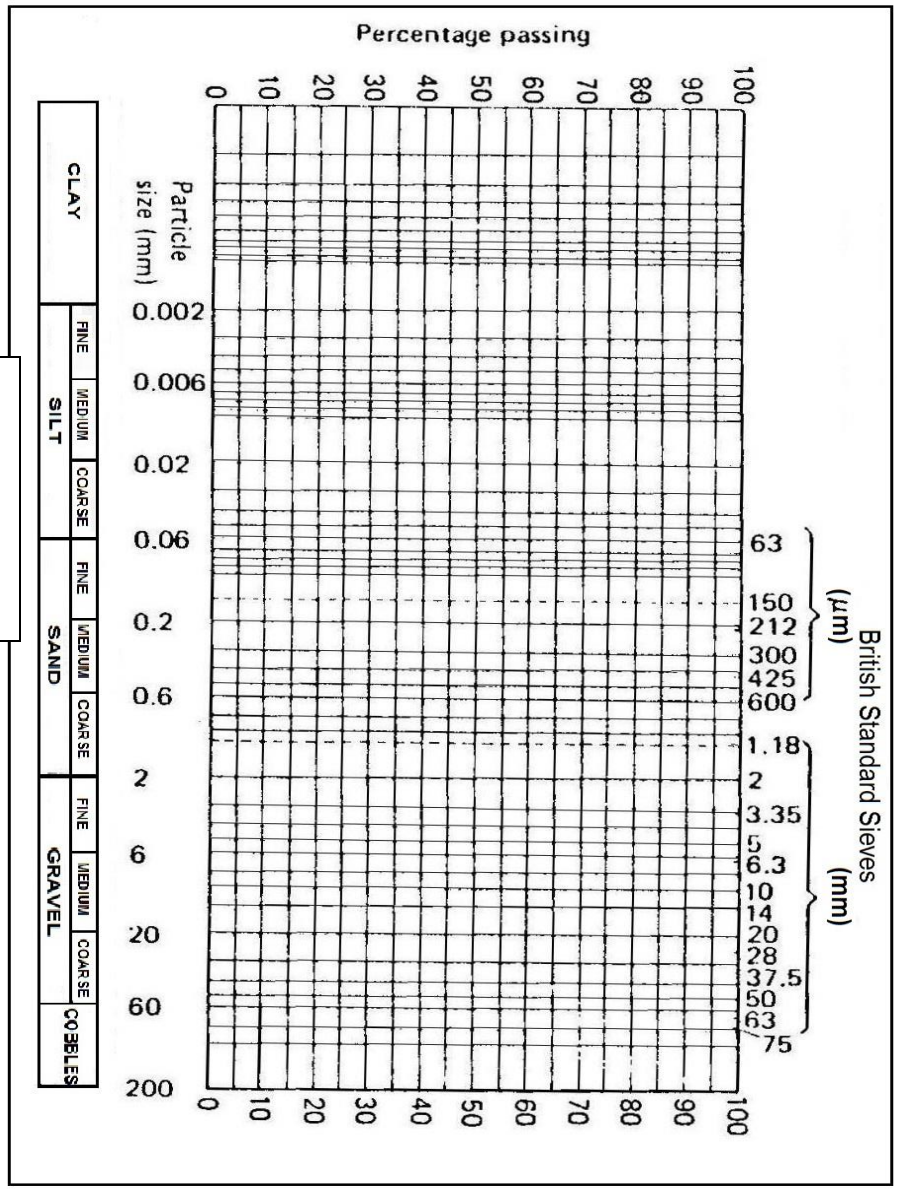

Fig.3

QUESTION FOUR

(a) Briefly describe a flownet (7marks)

(b) Coarse soil deposit of a construction site shown in figure 4 has particle specific gravity and porosity of 2.68 and 0.35 respectively. Coefficient of permeability fo the soil is 3.4×10^{-4}. Determine the following:

(i) Critical hydraulic gradient for the soil.

(ii) Quantity of seepage if the structure is 5m wide

(iii) Seepage pressure for shaded soil column.

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

(v) The height to which water would rise in a standpipe installed to point 'H'.

(14 marks)

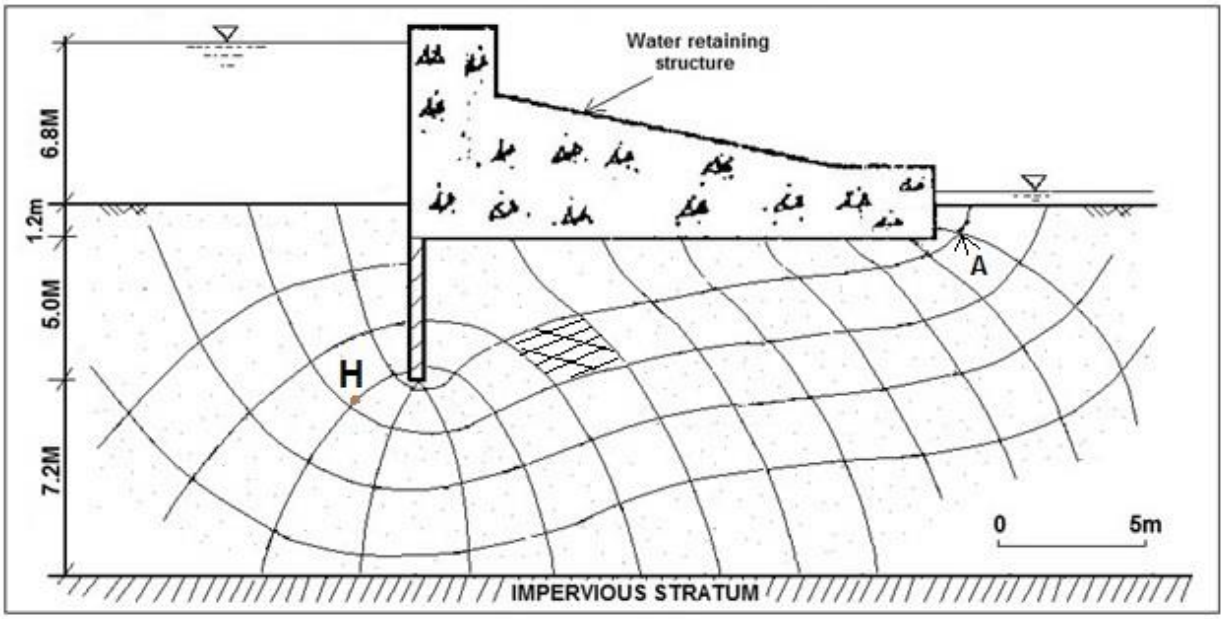

Fig.4

QUESTION FIVE

(a) Explain the following:

(i) Significance of determining moisture content of a soil before compaction process is embarked upon,

(ii) Use of 'air voids ratio' in soil compaction **(4 marks)**

(b) A coarse grained soil and a fine grained soil are designated as 'W' and 'H' respectively.

(i) Represent typical compaction curves for the soils on same axes,

(ii) Explain the relative positions for the two soils. **(5 marks)**

(c) The following data were obtained when a standard compaction test was performed on a dense clay soil of particle specific gravity = 2.65:

Sample number	**1**	**2**	**3**	**4**
Dry density (Mg/m^3)	1.57	1.59	1.58	1.56
Moisture content (%)	20	21.2	24.8	26

The results obtained when a fifth sample was tested under similar conditions were:

Mass of mould	5698
Mass of mould + compacted soil (g)	7658
Mass of compacted sub-sample taken before drying (g)	218
Mass of compacted sub-sample after drying (g)	178
Capacity of the mould used (cm^3)	1000

(i) Use the results to draw a compaction curve

(ii) Determine compaction parameters,

(iii) Calculate air voids ratio at compaction parameters obtained in (ii).

(11 marks)