ELIZADE UNIVERSITY, ILARA-MOKIN
FACULTY OF ENGINEERING
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

COURSE CODE: CVE 411 **SESSION/SEMESTER:** FIRST SEMESTER/ 2020/2021

COURSE TITLE: HIGHWAY ENGINEERING I

HOD'S SIGNATURE

LEVEL: 400L

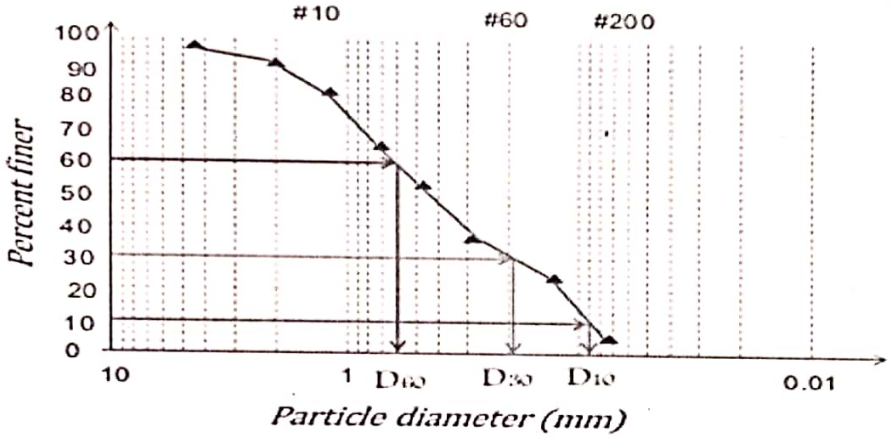
TIME ALLOWED: 2 HOURS 30 MINUTES

INSTRUCTION: ANSWER ANY FOUR QUESTIONS

Question 1 (15 marks)

(1a) Explain the following types of soil stabilization: (i) Mechanical stabilization (ii) Cement stabilization, (iii) Lime stabilization, (iv) Bituminous stabilization **(8 marks)**

(1b) Using the grain-size distribution curve shown below, determine the uniformity coefficient Cu and classify the soil **(4 marks)**



(1c) With the aid of a diagram, explain in details compaction specification of soils in the field. **(3 marks)**

Question 2 (15 marks)

(2a) Define and explain with the aid of diagrams the following parameters in geometric design of a highway (i) Horizontal Alignment (ii) Vertical alignment (iii) Cross-sectional elements **(6 marks)**

(2b) Explain the process for the determination of California Bearing Ratio (CBR), its applications in soil tests. **(6 marks)**

(2c) Laboratory tests were performed on a light-brown sandy soil (Table 2c) which visually has several pieces of gravel larger than 6mm. the result indicated that PL = 22.6% and LL = 33.2%. Classify the soil using USCS. **(3 marks)**

Table 2c: % passing through sieves

Sieve nos.	% Passing
4	98.0
40	36.5
200	28.5

Question 3 (15 marks)

(3a) With the aid of a diagram, explain the cross-sectional elements of a typical two lane highway with linear cross slopes. **(7 marks)**

(3b) Define the term 'Soil Compaction' listing its benefits in highway engineering **(5 marks)**

(3c) Write out the empirical formula to determine the group index (GI) of the soils and explain every term contained therein **(3 marks)**

Question 4 (15 marks)

(4a) List and explain the various surveys needed to be carried out in determining the geometric features for a road design **(5 marks)**

(4b) Explain the following factors affecting highway geometric design: (i) Design speed (ii) Topography (iii) Traffic factors (iv) Design hourly volume and capacity (v) Environmental factors **(10 marks)**

Question 5 (15 marks)

(5a) Using the information below, classify the soil according to the USCS:
% passing sieve No. 4 = 86%, D10 (mm) = 0.1, D60 (mm) = 0.9
% passing sieve No. 200 =12%, D30 (mm) = 0.32, PL =26%, PI =10% **(4 marks)**

(5b) A gravel or sandy soil is described as well graded or poorly graded, depending on the values of two shape parameters. Define these parameters, giving their formulas. **(3 marks)**

(5c) Explain the following terms in details giving relevant equations to support your explanations: (i) Full overtaking sight distance (FOSD). (ii) Overtaking time (iii) Safety time (iv) Closing time **(8 marks)**

Question 6 (15 marks)

(6a) Explain in details the term Urban highway systems alongside the following terms: (i) Urban minor arterial systems (ii) Urban collector street systems (iii) Urban local street systems (iv) Urban principal arterial systems **(8 marks)**

(6b) The results of the particle-size analysis of a soil are as shown in Table 6c.

Table 6c: % passing through sieves

Sieve nos.	% Passing
10	100
40	80
200	58

The liquid limit and plasticity index are 30 and 10 respectively. Classify the soil by the AASHTO system. **(7 marks)**

Table 2: USCS Definition of Particle Sizes

Soil Fraction or Component	*Symbol*	*Size Range*
1. Coarse-grained soils		
Gravel	G	75 mm to No. 4 sieve (4.75 mm)
Coarse		75 mm to 19 mm
Fine		19 mm to No. 4 sieve (4.75 mm)
Sand	S	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse		No. 4 (4.75 mm) to No. 10 (2.0 mm)
Medium		No. 10 (2.0 mm) to No. 40 (0.425 mm)
Fine		No. 40 (0.425 mm) to No. 200 (0.075 mm)
2. Fine-grained soils		
Fine		Less than No. 200 sieve (0.075 mm)
Silt	M	(No specific grain size—use Atterberg limits)
Clay	C	(No specific grain size—use Atterberg limits)
3. Organic soils	O	(No specific grain size)
4. Peat	Pt	(No specific grain size)

Gradation Symbols	*Liquid Limit Symbols*
Well graded, W	High LL, H
Poorly graded, P	Low LL, L

SOURCE: Adapted from *The Unified Soil Classification System*, Annual Book of ASTM Standards, Vol. 4.08, American Society for Testing and Materials, West Conshohocken, PA, 2002.