



**ELIZADE UNIVERSITY, ILARA-MOKIN**  
**FACULTY OF ENGINEERING**

**DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING**

**COURSE CODE: CVE 411      SESSION/SEMESTER: FIRST SEMESTER/ 2019/2020**

**COURSE TITLE: HIGHWAY ENGINEERING I**

**LEVEL: 400L**

**TIME ALLOWED: 3 HOURS**

**INSTRUCTION: ANSWER QUESTION 1, AND ANY OTHER THREE QUESTIONS**

**Question 1 (15 marks)**

- (1a)** The data in Table 1 is obtained from the mechanical analysis of a soil sample. Using the USCS method for classifying soils, determine the classification of the soil and state whether the soil is suitable in its natural state for use as a subbase material. Table 2 is the USCS classification of soil and aggregate materials. **(6 marks)**

**Table 1: Data from mechanical analysis**

Sieve Size (mm)	Plasticity Tests Results	Percent Fine
4.000	94.8	LL = 48%
3.350	94	PL = 42%
2.360	91.8	
1.000	78.4	
0.850	71.8	
0.710	71.6	
0.500	40.5	
0.425	40.3	
0.355	40	
0.212	19.4	
0.180	17.6	
0.150	13.2	
0.075	4.4	

- (1b)** Using the information in Table 3, plot the Cumulative frequency curve and estimate:
- (i) The 15<sup>th</sup> And 85<sup>th</sup> Percentile Speed **(3 marks)**
  - (ii) Full Overtaking Sight Distance (FOSD) **(3 marks)**
  - (iii) Stopping Sight Distance **(3 marks)**

**Table 3: Spot speed studies**

Speed Range (km/hr)	Frequency (f)
0-10	32
11-20	28
21-30	58
31-40	82
41-50	53
51-60	45
61-70	75
71-80	67
81-90	62
91-100	54

**Question 2 (15 marks)**

- (2a) Explain the engineering properties of SP-SM soil group (5 marks)  
(2b) With the aid of a diagram, explain the cross-sectional elements of a typical two lane highway with linear cross slopes. (10 marks)

**Question 3 (15 marks)**

- (3a) Define the term 'Soil Compaction' listing its benefits in highway engineering (3 marks)  
(3b) Explain the following types of soil stabilization: (i) Mechanical stabilization (ii) Cement stabilization, (iii) Lime stabilization, (iv) Bituminous stabilization (v) Electrical stabilization (vi) Thermal stabilization. (12 marks)

**Question 4 (15 marks)**

- (4a) Explain the process for the determination of California Bearing Ratio (CBR), its applications in soil tests. (7 marks)  
(4b) List and explain the various surveys needed to be carried out in determining the geometric features for a road design (4 marks)  
(4c) With the aid of a diagram, explain in details compaction specification of soils in the field. (4 marks)

**Question 5 (15 marks)**

- (5a) 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 (5 marks)  
(5b) 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% (5 marks)  
(5c) Define the term sleepers and itemize its main functions in rail technology. (5 marks)

**Question 6 (15 marks)**

- (6a) Write out the empirical formula to determine the group index (GI) of the soils and explain every term contained therein (3 marks)  
(6b) 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)  
(6c) Define and with the aid of diagrams the following parameters in geometric design of a highway (i) Horizontal Alignment (ii) Vertical alignment (iii) Cross-sectional elements (9 marks)

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