



FACULTY OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING
FIRST SEMESTER EXAMINATION (MARCH
2018)
2017/2018 ACADEMIC SESSION

HOD'S SIGNATURE

Instructions:

- 1) Attempt Four Questions
- 2) **Time Allowed:** 3 hrs
- 3) **SEVERE PENALTIES APPLY FOR MISCONDUCT,
CHEATING, POSSESSION OF UNAUTHORIZED
MATERIALS DURING EXAMINATION**

Course Title: Highway Engineering I

Course Code: CVE 411



**FACULTY OF ENGINEERING
DEPARTMENT OF CIVIL AND ENVIRONMENTAL
ENGINEERING**

Course Title: Highway Engineering I

Course Code: CVE411

Session: 2017/18

Semester: First

Level: 400

Instructions: Attempt Four Questions,

Time: 3 hrs

Question 1 (15 marks)

- a) Define soil from the civil engineering point of view. (2 marks)
- b) Explain the importance of Soil properties. (4 marks)
- c) State the knowledge of the characteristics and engineering properties of soils that are important to highway engineers. (3 marks)
- d) Briefly explain the following:
 - i. Physical weathering. (1.5 marks)
 - ii. Chemical weathering. (1.5 marks)
 - iii. Residual Soil. (1.5 marks)
 - iv. Transported Soil. (1.5 marks)

Question 2 (15 marks)

- a) Define soil compaction. (2 marks)
- b) Why is knowledge of optimum water content and the maximum dry unit weight of soils is very important? (3 marks)
- c) State the water content at which 95% level of compaction be attained. (5 marks)
- d) Draw a schematic diagram to illustrate the compaction specification of soils in the field. (5 marks)

Question 3 (15 marks)

- a) Explain the term "Soil Stabilization". (3 marks)
- b) Discuss the following methods of soil stabilization.
 - i. Cement stabilization (3 marks)
 - ii. Lime stabilization. (3 marks)
- c) What are the reasons that make cement stabilization the most popular method? (3 marks)
- d) State the factors that affect cement stabilization. (3 marks)

Question 4 (15 marks)

- a) The data in Table 1 is obtained from mechanical analysis, using the AASHTO method for classifying soils, determine the classification of the soil and state whether this material is suitable in its natural state for use as a subbase material. Table 2 is the AASHTO Classification of Soils and Soil Aggregate Mixtures. (10 marks)
- b) Draw a schematic diagram of typical two-lane highway with linear cross slopes. (5 marks)

Question 5 (15 marks)

- a) Enumerate varying survey needed to be conducted in determining the geometric features of road design. (6 marks)
- b) Briefly explain factors that affect highway geometric design. (9 marks)

Question 6 (15 marks)

- a) Explain the following:
- i. Sight distances (2.5 marks)
 - ii. Stopping sight distances. (2.5 marks)
- b) The forces on a vehicle negotiating a horizontal curve is as shown in Figure Q6. (10 marks)

Where: The angle of incline of the road (super elevation) is α ; μ is defined as the side friction factor. Side frictional force between the vehicle and the highway is P ; the reaction to the weight of the vehicle normal to the surface of the highway is N ; M is the mass of the vehicle. The centrifugal force acting horizontally on the vehicle and equals $C = \frac{MV^2}{R}$. Show that $\frac{V^2}{127R} = e + \mu$

Table 1: Data from Mechanical Analysis

Sieve No.	Percent Fine	Plasticity Tests
4	97	LL= 48%
10	93	PL= 26%
40	88	
100	78	
200	70	

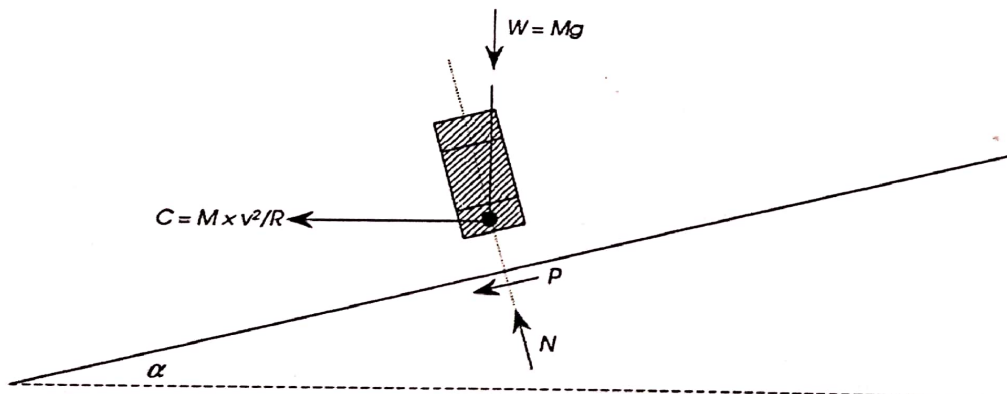


Figure Q6: vehicle negotiating a horizontal curve

Table 2: AASHTO Classification of Soils and Soil Aggregate Mixtures

General Classification	Granular Materials (35% or Less Passing No. 200)						Silt-Clay Materials (More than 35% Passing No. 200)					
	A-1			A-2			A-1			A-2		
Group Classification	A-1-a	A-1-b	A-3	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7	
Sieve analysis												
Percent passing												
No. 10	-50 max.	-	-	-	-	-	-	-	-	-	-	
No. 40	30 max.	50 max.	51 min.	-	-	-	-	-	-	-	-	
No. 200	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.	36 min.	36 min.	36 min.	36 min.	
Characteristics of fraction passing No. 40:												
Liquid limit	-	-	-	-	-	-	-	-	-	-	-	
Plasticity index	6 max.	-	N.P.	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	
Usual types of significant constituent materials	Stone fragments, gravel and sand	-	Fine sand	10 max.	10 max.	11 min.	11 min.	10 max.	10 max.	11 min.	11 min.	
General rating as subgrade	Excellent to good						Fair to poor					

*Plasticity index of A-7-5 subgroup \leq LL - 30. Plasticity index of A-7-6 subgroup $>$ LL - 30.

Source: Adapted from *Standard Specifications for Transportation Materials and Methods of Sampling and Testing*, 27th ed., Washington, D.C. The American Association of State Highway and Transportation Officials