(University of Choice)

# MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

## MAIN CAMPUS

## UNIVERSITY SPECIAL/ SUPPLEMENTARY EXAMINATIONS 2021/2022 ACADEMIC YEAR

## THIRD YEAR SECOND SEMESTER EXAMINATIONS

### FOR THE DEGREE
### OF
### BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING

**COURSE CODE:** CSE 342

**COURSE TITLE:** HIGHWAY GEOMETRIC DESIGN

**DATE:** 3ʳᴰ AUGUST 2022　　　**TIME:** 11 A.M. – 1 P.M.

**INSTRUCTIONS:**

1. This paper contains **FOUR** questions
2. Answer Question **ONE** and any other two
3. Marks for each question are indicated in the parenthesis.
4. Examination duration is **2 Hours**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

## Question 1 (30 marks): COMPULSORY

a)      With an aid of simple sketches describe the four categories of grade separated junctions.

**(12 marks).**

b)      Calculate the perception reaction time for a vehicle traveling at 90km/h given the coefficient of longitudinal friction is 0.35, the safe stopping sight distance is 170m and that is on a down gradient of 4%

**(4 marks)**

c)      Draw a typical single-way carriageway cross-section and clearly indicate the following features: Carriageway, verge, shoulders, slopes of cutting/embankment.      **(6 Marks)**

d)      A roadway is being designed for a speed of 80km/h on a horizontal curve, it is known that the superelevation is 6% and the coefficient of friction is 0.14. determine the minimum radius of the curve

**(3 marks).**

e)      A deer is running across the level road and a driver did his best to avoid hitting this deer by attempting to stop his car. However, during the braking, his car slid from the concrete pavement to the gravel shoulder but finally came to a halt safely. If the traveling speed of this car is 100 kph on the concrete pavement and 60 kph on the gravel shoulder. Calculate the coefficient of friction on the concrete pavement. Assuming that the lengths of skid marks on concrete pavement 100m. Reaction time is 1.5 sec.

**(5 marks)**

## Question 2 (20 marks)

a) You are in design team to come up with traffic signage for a newly constructed road. What are some of the factors to bear in mind when carrying out this assignment **(10 marks)**

b) Design speed is also referred to as the 85-percentile speed. Given the below set of data, calculate the design speed.      **(4 marks)**

| Speed range (km/h) | No. of observations |
|---|---|
| Less than 50 | 10 |
| 50-54 | 15 |
| 55-59 | 20 |
| 60-64 | 15 |
| 65-69 | 90 |
| 70-74 | 100 |
| 75-79 | 120 |
| 80-84 | 45 |
| 85-90 | 10 |

c) what is super elevation and why is important in horizontal alignment design. You can use a simple neat sketch to explain      **(6 marks)**

### Question 3 (20 marks)

a) You have been asked to do an intersection design for a suburban road section.

(i) What are the factors that you will consider in choosing the layout of the intersection (4 marks)

(ii) Suppose the intersection is to cater for about 5 road approaches, it is near a big institution and frequented mall. The traffic study revealed existence of a blended mix of vehicle types including motorized 2 and 3 wheelers. What type of intersection would you recommend and why **(6 marks)**

b) Briefly explain how to design an at grade intersection using the Kenya Road Design Manual Part I. **(6 marks)**

c) Determine the minimum length of curve required to connect a descending 3% grade to an ascending 4% grade. The design speed of the road is 80 km/h. **(4 marks)**

### Question 4 (20 marks)

a) A vehicle is negotiating a horizontal curve of 340m radius, and the rate of superelevation is 0.10 at a constant speed of 100km/h. The coefficient of friction is 0.32 and the perception reaction time may be taken as 2.5seconds. Assuming that the superelevation has a negligible effect on the stopping distance of the vehicle, calculate the required stopping sight distance. **(4 marks)**

b) Differentiate between summit curves and crest curves with the help of some neat sketches **(4 marks)**

c) There are number of key design and control criteria that come into play when designing road geometry, name and explain any four **(8 marks)**

d) There are two basic types of delineators. Mention them, their function, and the circumstances under which each type is used **(4 marks)**

## List of formulae

$$M = \frac{S^2}{8R}$$

$$M = \frac{L(2S-L)}{8R}$$

$$L_s = \frac{v^3}{CR_c} = \frac{V^3}{3.6^3 CR_c}$$

$$L_{min} = \frac{AS^2}{\left[(2h_1)^{\frac{1}{2}} + (2h_2)^{\frac{1}{2}}\right]^2}$$

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