(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY 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: THURSDAY 28TH APRIL 2022 TIME: 8.00 – 10.00 AM

INSTRUCTIONS:

1. This paper contains **two** sections
2. Answer **all** questions in **section I** and **any two** from section **II**
3. Marks for each question are indicated in the parenthesis.
4. A list of useful formulae is provided
5. Examination duration is **2 Hours**

MMUST observes ZERO tolerance to examination cheating

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

QUESTION ONE (COMPULSORY) (30 MARKS)

1.(a)Among the key design and control factors that affect the design of road geometry are road safety and road function. Describe them and explain how and which aspects of road geometry design they affect. **(4 marks)**

(b)Calculate the perception distance, braking distance and safe stopping sight distance for an approach vehicle speed of 15m/s where f= 0.27 and the perception reaction time is 2.5 seconds. Take g= 10m/s^2 **(4 marks)**

(c)Assuming the road in section a is a two-way two lane, where the lane width is 3m each. What is the required meeting sight distance **(2 marks)**

2. (a) The Kenya Road Design manual outlines the procedure of designing intersections. Briefly describe the four main steps taken to carry out the design. **(8 marks)**

(b)What is camber and what are the typical values of camber as per the Road design manual part I **(2 marks)**

3. (a)Determine the minimum length of the valley curve required to connect a descending 4% grade to and ascending 3% grade. The vertical clearance is to be 5.2 m and the required sight distance is 300 m. The height of eye for a commercial vehicle is 1.83 m and the hazardous object has a vertical height of 0.26m. Assume the sight distance is longer than the length of the curve. **(4 marks)**

(b)Mention any four factors to consider in the design of traffic signals and state why each is important **(6 marks)**

SECTION II – ANSWER ANY TWO QUESTIONS (40 MARKS

4 (a)State and briefly describe the main features that constitute horizontal alignment **(6 marks)**

(b)Sight distance is important in geometric design. State and explain the five key concepts of sight distance considered. **(10 marks)**

(c) 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)

5 (a) The selection of an appropriate design speed is based on a number of factors. Name and explain them. **(6 marks)**

(b) You have been appointed to improve road safety in the Country. In your analysis you determine part of the problem arises during design. Using our knowledge of Geometric Design and especially on road furniture, describe any four measures you will propose to design, modify or improve in order to enhance traffic safety. **(10 marks)**

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

6 (a)Explain the concept of superelevation. You can you a neat sketch and relevant formulae **(8 marks)**

(b). Where an analysis of the highway design speed is carried out, the design speed is determined on the basis of 3 factors, namely; mandatory constraint, layout constraint and alignment constraint. Briefly explain how each of them influences the determination of design speed. **(6 marks)**

(c) What are the conditions that warrant the use on a grade separation in intersection design **(6 marks)**

List of formulae

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

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

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

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

$$L_{min} = 2S - \frac{2\left(h_1^{\frac{1}{2}} + h_2^{\frac{1}{2}}\right)^2}{A}$$

$$L = \frac{AS^2}{8[C1 - (H_1+H_2)/2]}$$

$$L = 2S - \frac{8[C1 - (H1+H2)/2]}{A}$$