



**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR**

THIRD YEAR SEMESTER TWO EXAMINATIONS

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

COURSE CODE: CSE 342

COURSE TITLE: HIGHWAY GEOMETRIC DESIGN

DATE: THURSDAY 5TH NOVEMBER 2020 TIME: 9.00 – 11.00 AM

INSTRUCTIONS:

1. This paper contains FOUR questions
2. QUESTION ONE IS COMPULSORY
3. Attempt any other TWO questions
4. Marks for each question are indicated in the parenthesis.

Examination duration is **2 Hour**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

Question ONE (30 marks)

- (a) Discuss **THREE** Factors that affect highway geometric design **[6 Marks]**
- (b) Two platoons of cars are timed over a distance of 0.5km. Their flows are recorded. The first group is timed at 30 seconds, with the flow at 1500 vehicles per hour. The second group take 40 seconds, with a flow of 1800 vehicles per hour. Determine the maximum flow of the traffic stream. **[6 Marks]**
- (c) Calculate the minimum sight distance required to avoid a head on collision of two cars approaching from the opposite direction at 72 and 43.2 kmph. Assume a reaction time of 2.5 seconds, coefficient of friction of 0.7 and a brake of 75% efficient, in either case **[6 Marks]**
- (d) A 2.5% grade is connected to a 1.0% grade by means of a 180 m vertical curve. The P.I. station is 100 00 and the P.I. elevation is 100.0 m above sea level. What are the station and elevation of the lowest point on the vertical curve? **[6 Marks]**
- (e) Define traffic islands and Outline **FIVE** reasons why traffic islands are generally included in the design of junctions **[6 Marks]**

Question TWO (20 marks)

- (a) With an aid of neat sketches describe the four categories of grade separated junction **[17 Marks]**
- (b) Outline the purpose of providing camber in design of highway carriage way **[3 Marks]**

Question THREE (20 marks)

- (a) A highway passing through a rolling terrain has a horizontal curve radius equal to the ruling minimum radius.
- i. Design all the geometric features of this curve **[11 Marks]**
- ii. Specify the minimum set-back distance from the center line of the two lane highway on the inner side of the curve up to to which the buildings e.t.c obstructing vision should not be constructed so that intermediate sight distance is available throughout the circular curve. **[3 Marks]**

Assume the following data

Length of circular curve is greater than the sight distance

For rolling terrain, ruling Design speed, $V=80\text{km/h}$

Maximum value of super elevation $e=7\%$ and coefficient of friction $f= 0.15$

Assume two lane pavement $n=2$ and wheel base of truck $l=6$

Normal pavement width $W=7\text{m}$

The pavement is to be rotated about the center at a rate of 1 in 150

- (b) Describe the **THREE** aspects of the pavement surface that are important for safe and comfortable

driving

[6 Marks]

Question FOUR (20 marks)

(a) Outline FIVE Guidelines which must be applied for coordination of horizontal and vertical alignments

[5 Marks]

(b) A vertical summit curve is to be designed with two grades +2% and 1.25% meet on a highway. The stopping sight distance and overtaking sight distance required are 180 and 640 m respectively. But due to site conditions the length of vertical curve has to be restricted to a maximum value of 500 m if possible. Calculate the length of summit curve needed to fulfil the requirement of

i. Stopping sight distance

[3 Marks]

ii. Overtaking sight distance or at least intermediate sight distance and discuss the results.

[4 Marks]

(c) Calculate the length of transition curve and shift using the following data

Design speed = 65 kmph

Radius of circular curve = 220m

Allowable rate of introduction of super elevation (pavement rotated about the centre line = 1 in 150

Pavement width including extra widening = 7.5m

[8 Marks]