# TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF BUILDING & CIVIL ENGINEERING
**UNIVERSITY EXAMINATION FOR:**

BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING

TCV 4323: HIGHWAY GEOMETRIC DESIGN

SPECIAL/SUPPLEMENTARY EXAMINATION
**SERIES:** MARCH 2025
**TIME:** 2 HOURS

**Instructions to Candidates**
You should have the following for this examination
*-Answer Booklet, examination pass and student ID*
This paper consists of **five** questions.
Attempt question ONE (Compulsory) and any other TWO questions.
**Do not write on the question paper.**

**QUESTION ONE (COMPULSORY) 20 Marks**

a) The Kenya road design manual outlines the procedure of designing intersections. Briefly describe the four main steps taken to carry out the design. (4 marks)

b) A 2-lane 7.3m wide single carriageway road has a curve radius of 600m. The minimum sight stopping distance required is 160m. Calculate the required distance to be kept clear of obstructions in metres. (3 marks)

c) What is an acceleration lane? Acceleration lanes are determined by two factors: mention them. (3 marks)

d) With the aid of a sketch, describe a deceleration lane (4 marks)

e) Sketch the layout of typical roundabout showing all the necessary design requirements. (6 Marks)

**ANSWER ANY TWO QUESTIONS FROM THIS SECTION**

**QUESTION TWO (20 marks)**

a) List **SEVEN** points that should be considered in the general layout of a roundabout (7 marks)

b) Explain the factors affecting highway alignment design (9 marks)

c) Calculate the *desired* and *absolute* minimum crest curve lengths for a dual carriageway highway with a design speed of 100km/hr where the algebraic change in gradient is 7% (from +3% (uphill) to -4% (downhill)). (4 marks)

**QUESTION THREE (20 Marks)**

a) Discuss briefly **THREE** methods for draining water from a highway (6 marks)

b) Define "Design speed" and explain how its choice affects the design of the geometric design elements. (5 marks)

c) A vertical crest curve on a single carriageway road with a design speed of 85 km/hr is to be built in order to join an ascending grade of 4% with a descending grade of 2.5%. The motorist's eye height is assumed to be 1.05m while the object height is assumed to be 0.26m.

i. Calculate the minimum curve length required in order to satisfy the requirements of minimum sight stopping distance

ii. Recalculate the minimum curve length with the object height assumed to be zero. (9 marks)

**QUESTION FOUR (20 Marks)**

a) Explain the **THREE** basic ways of resolving crossing conflict at intersections (3 marks)

b) With the aid of a sketch of Channelization of traffic through a four-legged intersection explain the term "channelization" and state its purposes (7 marks)

c) What is "superelevation"? (2 marks)

d) i. What is the minimum radius of curvature allowable for a roadway with a 100 km/h design speed, assuming that the maximum allowable super elevation rate is 0.12?

ii) What is the actual maximum super elevation rate allowable under AASHTO recommended standards for a 100 km/h design speed, if the value of μ is the maximum allowed by AASHTO for this speed? Round the answer down to the nearest whole percent. (Refer to Tables 1.2 & 1.3) (8 marks)

**QUESTION FIVE (20 Marks)**

A vertical crest curve on a single carriageway road with a design speed of 85 km/hr is to be built in order to join an ascending grade of 4% with a descending grade of 2.5%. The motorist's eye height is assumed to be 1.05m while the object height is assumed to be 0.26m.

i. Calculate the minimum curve length required in order to satisfy the requirements of minimum sight stopping distance

ii. Recalculate the minimum curve length with the object height assumed to be zero. (10 marks)

Stopping sight distances for different design speeds

| Stopping sight distance (m) | Design speed (km/hr) | | | | | |
|---|---|---|---|---|---|---|
| | 120 | 100 | 85 | 70 | 60 | 50 |
| Desirable minimum | 295 | 215 | 160 | 120 | 90 | 70 |
| Absolute minimum | 215 | 160 | 120 | 90 | 70 | 50 |

iii. Using the same basic data as above but with the following straight line gradients:

p = +0.02
q = -0.02

Calculate the required curve length assuming a motorist's eye height of 1.05 m and an object height of 0.26m. (10 marks)

**Table 1.2:**

**Values of side friction recommended by AASHTO**

| Design speed, km/h | Maximum side friction factor |
|---|---|
| 30 | 0.17 |
| 40 | 0.17 |
| 50 | 0.16 |
| 60 | 0.15 |
| 70 | 0.14 |
| 80 | 0.14 |
| 90 | 0.13 |
| 100 | 0.12 |
| 110 | 0.11 |
| 120 | 0.09 |

*Source:* From *A Policy on Geometric Design of Highways and Streets.* Copyright 1994 by the American Association of State Highway and Transportation Officials, Washington, DC. Used by permission.

**Table 1.3:**

**Recommended minimum radius of curvature**

| Design speed, km/h | Manimum curve raidus, m |
|---|---|
| 30 | 35 |
| 40 | 60 |
| 50 | 100 |
| 60 | 150 |
| 70 | 215 |
| 80 | 280 |
| 90 | 375 |
| 100 | 490 |
| 110 | 635 |
| 120 | 870 |

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