



TECHNICAL UNIVERSITY OF MOMBASA

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

**BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING
TCV4323: HIGHWAY GEOMETRIC DESIGN**

**SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: NOVEMBER 2024
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 and any other TWO questions.

DO NOT WRITE ON THE QUESTION PAPER.

QUESTION ONE (COMPULSORY) (30 marks)

- a) Explain the two major design steps that are to be considered when designing a road? (2 marks)
- b) Explain the FOUR steps involved in junction design (4 marks)
- c) Define “design speed” and explain how its choice affects the design of the geometric design elements. (5 marks)
- d) Draw a typical single carriageway cross section and clearly indicate all its features. (7 marks)
- e) One of the main objectives of traffic control at intersections is to minimize the delays or travel time of the traffic units. Mention and explain the two forms of delay that affect the traffic units. (5 marks)
- f) Given a design speed of 100km/hr and that at one section of a highway, an equal tangent vertical curve must be designed to connect grades of +1.0% and -2%, determine the minimum length of a curve necessary to meet stopping sight distance requirements. (7 marks)

ANSWER ANY TWO QUESTIONS FROM THIS SECTION

QUESTION TWO (20 Marks)

- a) Mention and briefly explain each of the THREE basic elements of geometric design (6 marks)

- b) Define “Design speed” and explain how its choice affects the design of the geometric design elements. (5 marks)
- c) A circular curve has 300 m radius and 60° deflection angle. Calculate:
- length of curve,
 - tangent length,
 - length of long chord,
 - mid-ordinate and
 - Apex distance.
- (9 marks)

QUESTION THREE (20 Marks)

- a) With the aid of sketches, discuss the following types of roundabouts:
- Double roundabout
 - Normal roundabout
- (6 marks)
- b) What is a transition curve? Explain THREE main purposes of introducing transition curves (7 marks)
- c) A highway with a design speed of 100 km/hr is designed with a sag curve connecting a descending gradient of 3% with an ascending gradient of 5%.
- If comfort is the primary design criterion, calculate the required length of the sag curve (comfort criterion).
 - If a bridge structure were to be located within the sag curve, with a required clearance height of 5.7m, then assuming a driver’s eye height of 2m and an object height of 0.26m, calculate the required length of the sag curve (clearance criterion). (7 marks)

QUESTION FOUR (20 Marks)

- a) What is “superelevation”? (2 marks)
- b) Explain the primary reasons for widening horizontal curves (2 marks)
- c) Using sketches, explain the term “channelization” and state its purposes. (8 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 down the answer to the nearest whole percent. (Refer to Tables 1.2 & 1.3)
- (8 marks)

QUESTION FIVE (20 Marks)

- a) Define the term “cross fall” as used in highway design (2 marks)
- b) Calculate and tabulate deflection angles and chords at 20 m intervals for a 500 m radius curve with a deflection angle of 15° and a TC at station 17 + 25. (18 marks)