



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

END OF SEMESTER EXAMINATION

SERIES: JANUARY 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) Define "Design speed" and explain how its choice affects the design of the geometric design elements. (5 Marks)
- b) State **TWO** reasons for widening horizontal curves. (2 Marks)
- c) Draw a typical single-way carriageway cross-section and indicate clearly the following features: Carriageway, verge, shoulders, slopes of cutting/embankment. (4 marks)
- d) Discuss the following terms as used in highway geometric design
 - (i) Central Islands
 - (ii) Road kerbs(4 marks)
- e) Define super elevation and state its advantage on road design (2 marks)



TUM is ISO 9001:2015 Certified

- f) Differentiate between summit curves and crest curves with the help of some neat sketches (3 marks)

ANSWER ANY TWO QUESTIONS FROM THIS SECTION

QUESTION TWO (20 marks)

- a) Give **TWO** main goals of Highway geometric design (2 marks)
- b) Define the term “cross falls” as used in highway design (2 marks)
- c) Differentiate “At-grade” intersections from “Grade-separated” intersections and explain the factors that govern or justify the choice of grade-separated intersections. (6 Marks)
- b) A vertical alignment for a single carriageway road consists of a parabolic crest curve connecting a straight-line uphill gradient of +4% with a straight line downhill gradient of -3%.
- (i) Calculate the vertical offset at the point of intersection of the two tangents at PI
- (ii) Calculate the vertical and horizontal offsets for the highest point on the curve.
- Assume a design speed of 85km/hr and use the absolute minimum K value for crest curves. (10 marks)

QUESTION THREE (20 Marks)

- a) What is a transition curve? Explain **THREE** main purposes of introducing transition curves (7 marks)
- b) Explain the term “channelization” and state its purposes (4 marks)
- c) A circular curve has 300 m radius and 60° deflection angle. Calculate:
- (i) length of curve,
- (ii) tangent length,
- (iii) length of long chord,
- (iv) mid-ordinate and
- (v) Apex distance. (9 marks)

QUESTION FOUR (20 Marks)

- a) State **FOUR** objectives of accidents studies on highway (4 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. (16 marks)

QUESTION FIVE (20 Marks)

- a) You have been appointed to improve road safety in the country. Using your knowledge of geometric design, explain the **THREE** measures useful in preventing road traffic accidents (6 marks)
- b) Determine the length of transition curve for the design speed of 80 kmph to negotiate a curve of radius 300 m. to avoid discomfort to the passengers, take $c=0.5$ (4 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%.
- (i) If comfort is the primary design criterion, calculate the required length of the sag curve (comfort criterion).
- (ii) 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). (10 marks)