



# TECHNICAL UNIVERSITY OF MOMBASA

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## FACULTY OF ENGINEERING AND TECHNOLOGY DEPARTMENT OF BUILDING & CIVIL ENGINEERING UNIVERSITY EXAMINATION FOR: BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECV 4415: HIGHWAY ENGINEERING 1 **PAPER 2**

SPECIAL/SUPPLEMENTARY EXAMINATION

**SERIES: JULY 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) (30 Marks)**

- (a) (i) Draw a typical single carriageway cross section clearly indicating its features (7 Marks)
- (ii) State three main factors that determine the choice of a highway cross-section (3 marks)
- (b) Outline the main functions of the following features of a highway (9 marks).
  - (i) Central reservation/Median strip
  - (ii) Shoulders
  - (iii) Drainage channels
- (c) With aid of a sketch, outline two ways of designating a curve. (3 Marks)
- (d) (i) Define a priority intersection giving its principal advantage over other types of intersections (2 Marks)



- (ii) With aid of sketches illustrate three forms of priority intersections **(6 Marks)**

## ANSWER ANY TWO QUESTIONS FROM THIS SECTION

### QUESTION TWO (20 Marks)

a) Define the following terms as used in highway design and outline the three components of each term. (8 Marks):

- (i) Stopping sight distance
- (ii) Overtaking sight distance

b) Calculate the full overtaking sight distance (FOSD) for the 85th percentile driver on a section of highway with a design speed of 85km/hr ( 4 Marks)

c) With aid of a sketch, briefly explain *why a right-left stagger* is preferred to the left-right stagger for a staggered T- junctions. (5 Marks)

### QUESTION THREE(20 Marks)

(a) Define a transition curve and explain its threefold purpose in horizontal curves. **(8 Marks)**

(b) Referring to table Q2(b), Calculate the *desired* and *absolute* minimum crest curve lengths for a vertical curve to be constructed between an ascending grade of 3% and a descending grade of 4% for a dual carriageway highway with a design speed of 100km/hr. **(6Marks)**

Table Q2(b): K values for vertical curvature

|                                                                                       | Design speed (km/hr) |     |     |     |     |     |
|---------------------------------------------------------------------------------------|----------------------|-----|-----|-----|-----|-----|
|                                                                                       | 120                  | 100 | 85  | 70  | 60  | 50  |
| Desirable minimum K value – Crest curves<br>(not recommended for single carriageways) | 182                  | 100 | 55  | 30  | 17  | 10  |
| Absolute minimum K value – Crest curves                                               | 100                  | 55  | 30  | 17  | 10  | 6.5 |
| Absolute minimum K value – Sag curves                                                 | 37                   | 26  | 20  | 20  | 13  | 9   |
| Full overtaking sight distance (FOSD) K<br>value – Crest curve                        | —                    | 400 | 285 | 200 | 142 | 100 |

(c) Roads in Kenya are divided into classes according to their major function in the road network. Outline the highest three classes. **(6 Marks)**

#### **QUESTION FOUR(20 Marks)**

- (a) With aid of a clear sketch, outline the elements of a simple circular horizontal curve (8 Marks).
- (b) With the aid of diagrams, illustrate the following types of roundabouts ( 12 Marks)

#### **QUESTION FIVE (20 Marks)**

- (a) With aid of sketches, outline four types of horizontal curves (8 marks)
- (b) (i) Define degree of curvature and with aid of a sketch derive a formula relating the Degree of curvature and the Radius of the curve. ( 4 Marks)
- (ii) Using the relationship between the degree of curvature (D) and the radius of the curve ( R), and given that the sight distance length (SD) lies within the curve length, with aid of a sketch, derive the formula for computing the Minimum offset clearance (Ms) required between the centreline of the highway and an obstruction restricting the sight distance (8 Marks).