



A Centre of Excellence

TECHNICAL UNIVERSITY OF MOMBASA (TUM)

UNIVERSITY REGULAR EXAMINATIONS FOR:

BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING

TCV 4323: HIGHWAY GEOMETRIC DESIGN

REGULAR EXAMINATION

SERIES: 2024/2025

TIME: 2 HOURS

Instructions to Candidates:

1. You should have answer booklet for this examination.
 2. This paper contains **FIVE** questions
 3. Answer **ALL** questions.
 4. Marks for each question are indicated in the parenthesis.
 5. Examination duration is **2 Hours**
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TCV4323: HIGHWAY GEOMETRIC DESIGN

QUESTION ONE (20 MARKS)

- (a) Discuss briefly road classifications. (5Marks)
- (b) Two drivers each have a reaction time of 2.5 seconds. One is obeying a 100km/h speed limit and the other is travelling illegally at 110km/h. How much distance will each of drivers cover while perceiving/reaching to the need to stop, and what will the total stopping distance be for each driver (assuming the deceleration rate, $a=3.4\text{m/s}^2$ and the grade, $G=-3\%$). (10 Marks)
- (c) A motorist travelling at 100km/h down a grade of 4% on a highway observes a crash ahead of him, involving an overturned truck that is completely blocking the road. If the motorist has a perception reaction time of 2.5 sec; and the road surface friction is 0.35; what is the safest minimum distance that he should cover before stopping his vehicle? (5Marks)

QUESTION TWO (20 MARKS)

- (a) Discuss vertical alignment using appropriate sketches and types of vertical curves. (10 Marks)
- (b) Explain types of carriageway lanes. (5 Marks)
- (c) Using illustrations explain five at grade intersections. (5 Marks)

QUESTION THREE (20 MARKS)

- (a) List five soil primary tests. (5 Marks).
- (b) Explain flexible pavement distresses in pavement maintenance. (10 Marks)
- (c) Explain functional evaluation of maintenance. (5 Marks)

QUESTION FOUR (20 MARKS)

- (a). Calculate the minimum passing sight distance required for a two-lane rural roadway that has a posted speed limit of 80km/h. The local traffic Engineer conducted a speed study of the subject road and found the following:- average speed of the passing vehicle was 90km/h with initial and passing maneuver times 4 and 10 seconds respectively, an average acceleration of 2.5 km/h/sec and the average speed impeder vehicles was 70km/h. Given the safe distance between the passing and opposing vehicles is 35m. Calculate initial maneuver distance, the passing distance on opposing lane, the distance travelled by opposing vehicle and the passing sight distance (PSD) (10 marks).
- (b). A crest vertical curve of 600 m length connects +4% and -2% grades. The PVC at Station 2+100 and a point on the curve is located at station 2+450 and elevation 55m. Determine the elevation of PVC, PVT and the highest point on the curve. (10 marks).

QUESTION FIVE (20 MARKS)

- 5 (a) Computing rate of run off using the rational formula a 185 – acre urban drainage area consists of three different watershed areas as follows. Apartment dwelling areas = 50%, Parks = 30% and playgrounds = 20%. If the time on concentration for the drainage area is 1.6 hrs, determine the run off rate for a storm of 100 – year frequency. Assume that

the rainfall-intensity is 2.4 and the run off coefficients as follows:- apartment dwelling areas = 0.6, Parks = 0.175 and Playgrounds – 0.3. (5 marks)

(b) Design the length of summit curve formed at intersection of two gradients 3% and -5% to provide a stopping distance (SSD) for a design speed of 80kmph. (7 marks).

(c). A vertical curve is to be designated for two grades + 1/40 and – 1/80 meeting on a highway. Due to some local conditions, the stopping sight distance (SSD) and overtaking sight distance (OSD) are to be kept as 180 m and 700 m respectively and also the length of the curve cannot be more than 500 m. Calculate the length of the curve in above conditions for SSD and OSD or ISD. (8 marks).