



# TECHNICAL UNIVERSITY OF MOMBASA

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FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

**UNIVERSITY EXAMINATION FOR:**

**BSC IN CIVIL ENGINEERING**

**ECE 2404 : HIGHWAY ENGINEERING I**

**END OF SEMESTER EXAMINATION**

**SERIES: APRIL 2016**

**TIME: 2 HOURS**

**DATE: 17 May 2016**

## **Instructions to Candidates**

You should have the following for this examination

-*Answer Booklet, examination pass and student ID*

-*Drawing instruments.*

This paper consists of **FIVE** questions.

Attempt question ONE (Compulsory) and any other TWO questions.

**Do not write on the question paper.**

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## **Question One (Compulsory)**

- (a) When deciding the design standards to which a road shall be built, it is important to recognize the cost of the road and its value to the society it will serve. Discuss.  
(4 marks)
- (b) Mention and briefly explain each of the three main parts of geometric roadway design.  
(6 marks)
- (c) A highway is being designed with 113km/hr design speed and at one section, an equal tangent vertical curve must be designed to connect grades of +1.0% and -2%. Determine the minimum length of curve necessary to meet stopping sight distance requirements.  
(8 marks).

(d) Discuss the three topographic classifications that determine the physical location, alignment, gradients, sight distances and cross – sections of a road or highway. (4 marks)

(e) Define “channelization” and explain its purpose using appropriate diagrams. (8 marks)

### Question Two

(a) Mention and briefly explain the three important elements of intersection design. (6 marks)

(b) Passing sight distance can be analysed by dividing the overall distance into three parts. Briefly explain these three parts. (5 marks)

(c) Show how passing sight distance can be calculated by making certain fundamental assumptions. (9 marks)

### Question Three

(a) Draw a sketch to illustrate curve widening and give four primary reasons for curve widening. (10 marks)

(b) Using your sketch in Q2 (a) above, show how the extra width is calculated and highlight the points to be noted when widening horizontal curves. (4 marks)

(c) Define “super elevation” and show how it is introduced from a normal camber to a full super elevation. (6 marks)

### Question Four

(a) Name and illustrate six “at – grade” junction maneuvers. (3 marks)

(b) Differentiate “at grade” intersections from “grade - Separated” intersections and outline the three methods which may be used to achieve maximum safety and minimum delay to vehicles in at-grade intersections. (5 marks)

(c) Outline the three (3) situations which warrant the introduction of climbing lanes and state two factors considered when designing vertical curves. (5 marks)

(d) A vertical curve is to be constructed between an ascending grade of 2.5% and a descending grade of 3%. The required safe stopping distance is 230m. A dangerous object is at the carriageway level and the motorist’s eye height is 1.0m. Determine the minimum length of the vertical curve that will satisfy this sight distance requirement. (7 marks)

### Question Five

Explain the five key classes of roads in Kenya.

(5 marks)

Explain the following factors which will influence the choice of providing a roundabout or some other form of junction control:

- i. Safety
- ii. Traffic flow
- iii. Site Conditions
- iv. Driver Behavior

(6 marks)

- (e) Define a transition curve and explain its purpose in horizontal curves and estimate the minimum length of spiral necessary for a smooth transition from tangent (straight) to the circular curve. The curve radius is 350m and the design speed (VD) is 110kph. Friction is 0.4.

(9 marks)