



**DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY**

**UNIVERSITY EXAMINATIONS - 2013/2014**

**FOURTH YEAR FIRST SEMESTER EXAMINATIONS**

**FOR THE DEGREE OF BACHELOR OF SCIENCE IN CIVIL  
ENGINEERING**

**ECE 2404: HIGHWAY ENGINEERING I**

**DATE: 13<sup>TH</sup> AUGUST 2013**

**TIME: 11.00AM-1.00PM**

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**INSTRUCTIONS TO CANDIDATES**

- This paper contains **FOUR** questions
- Attempt **QUESTION ONE (1)** and any other **TWO** questions
- **QUESTION ONE (1)** carries **30 Marks** while the rest carry **20 Marks** each
- Use a scientific non-programmable calculator
- Erasers, pens and pencils will be required
- **ALL** workings should be shown on the provided answer booklets
- Cell phones and any written materials are **NOT** allowed in the examination room

**QUESTION ONE (1)**

- a) An equal-tangent vertical curve is to be constructed between grades of  $-2\%$  (initial) and  $+1\%$  (final), somewhere along Thika Road. The Point of Intersection (PI) is at chainage  $3 + 700$ , and at elevation  $150m$ . Due to an underpass crossing the carriageway, the elevation of the carriageway at chainage  $3 + 760$  must be at  $151.5m$ . Design the vertical curve. **(20 Marks)**

- b) Discuss the following four elements of the pavement surface, clearly stating how they affect safety and riding comfort.
- i. Friction
  - ii. Unevenness
  - iii. Light reflection
  - iv. Camber
- (10 Marks)**

## QUESTION TWO (2)

- a) A roadway is being designed for a speed of  $100 \text{ km/h}$ . At one horizontal curve, it is known that the superelevation is 6% and the coefficient of side friction is 0.15. Determine the minimum radius of curve (measured along the traveled path) that will provide for safe vehicle operation. **(4 Marks)**
- b) The safe and efficient operation of vehicles on the road depends very much on the visibility of the road ahead of the driver. Define the term 'sight distance' and discuss important considerations that an engineer should bear in mind while computing the desired sight distance for a particular situation **(16 Marks)**

## QUESTION THREE (3)

- a) Briefly describe transition curves and list five objectives for providing them in the horizontal alignment **(8 Marks)**
- b) Calculate the setting out data for a circular curve of radius  $400 \text{ m}$  connecting two straight sections of road with deflection angle of  $20^\circ$ . The chainage of the intersection point is 2+000 and the centerline pegs are to be located at 20m chainage. **(12 Marks)**

## QUESTION FOUR (4)

- a) What constitutes highway geometric design? Discuss five factors that affect the geometric design of a highway **(15 Marks)**
- b) An existing horizontal curve has a radius of 85m, which restricts the maximum speed on the section of road to 60% of the design speed of the highway. Highway officials want to improve the road to eliminate this bottleneck. Assuming the coefficient of side friction is 0.15 and rate of super-elevation is 0.08, compute the existing speed, design speed, and find the new radius of curvature given that the coefficient of friction at the design speed of the highway is 0.14 **(5 Marks)**