Instructions to Candidates:
You should have the following for this examination
- Answer Booklet
- Pocket Calculator

This paper consists of FOUR questions. Answer question ONE (COMPULSORY) and any other TWO questions

Maximum marks for each part of a question are as shown

Use neat, large and well labeled diagrams where required

This paper consists of TWO printed pages

Question One (Compulsory)

a) Differentiate “At-grade” intersections from ‘Grade-separated’ intersections

   (2 marks)

b) State the factors which control the geometric design elements of a road and list the benefits for proper geometric design

   (3 marks)
c) Define “Design Speed” and explain how its choice affects the design of the geometric design elements (5 marks)

d) Define the term “channelization and explain its purposes. (10 marks)

**Question Two**

a) Explain the purposes of transition curves and state the THREE major factors governing their design (5 marks)

b) Explain the THREE methods which may be used to achieve maximum safety and minimum delay to vehicles in at-grade intersections and with aid of sketches, show the following vehicle movements at intersections:
   (i) Diverging
   (ii) Merging
   (iii) Compound crossing and merging (7 marks)

c) Describe the FIVE factors related to the roads as a physical feature in the environmental to be considered in the location and design of a road project (8 marks)

**Question Three**

a) Outline how the following features affect the design of the principal geometric design elements: (10 marks)
   (i) Topography
   (ii) Traffic volume and capacity
   (iii) Roads classification
   (iv) Environmental effects
   (v) Design speed

b) With aid of sketches, explain how the superelevation is developed from a normal camber to a full superelevation at the centre of the circle curve (10 marks)

**Question Four**

a) Outline the THREE situations which warrant the introduction of climbing lanes and state TWO factors considered when designing vertical curves (5 marks)

b) Explain the purpose of intersection islands and differentiate kerbed islands from ghost islands (5 marks)

c) State the advantages and disadvantages of roundabouts as compared to other types of at-grade intersections (10 marks)

**Question Five**

a) Explain the primary reasons for widening horizontal curves (2 marks)

b) Define “design speed” and explain how its choice affects the design of the geometric design elements (5 marks)

c) Draw a typical single-way carriageway cross-section and indicate clearly the following features:
   (i) Verge
   (ii) Berm
   (iii) Carriageway slopes (i.e. cutting and embankment) (5 marks)
b) Outline the term “channelization” and state its purposes (8 marks)