3083/202
HIGHWAY ENGINEERING I
Oct./Nov. 2010
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

HIGHER DIPLOMA IN CONSTRUCTION
(HIGHWAY ENGINEERING OPTION)

HIGHWAY ENGINEERING I

3 hours

INSTRUCTIONS TO CANDIDATES:

You should have the following for this examination:

   Answer booklet
   Scientific calculator

Answer any FIVE of the following EIGHT questions.
All questions carry equal marks.
Maximum marks for each part of a question are as shown.

This paper consists of 3 printed pages.

Candidates should check the question paper to ascertain that all the
pages are printed as indicated and that no questions are missing.

Turn over

1. (a) State **three** reasons for compacting soil in road construction. (3 marks)

   (b) Explain **four** factors influencing the compaction of soils. (8 marks)

   (c) List **five** types of compacting plant stating the soil type each is suited for. (5 marks)

   (d) (i) Define "road grading" stating its purpose.
       (ii) Outline **two** types of road grading. (4 marks)

2. (a) (i) Define the term "bitumen"
       (ii) Outline **three** types of bitumen used in road construction. ($5\frac{1}{2}$ marks)

   (b) With the aid of sketches describe **two** laboratory tests for bitumen. (9 marks)

   (c) Describe the procedure of manufacturing an emulsion premix by hand. ($5\frac{1}{2}$ marks)

3. (a) State **four** functional requirements of a road drainage system. (4 marks)

   (b) Explain **two** phases of design for road drainage. (6 marks)

   (c) With the aid of a sketch in each case, describe the:

       (i) Lowering of ground water table.
       (ii) Control of capillary vise. (8 marks)

   (d) Explain **two** reasons for introducing transition curves on roads. (2 marks)

4. (a) Distinguish between rigid and flexible pavements. (2 marks)

   (b) Outline **five** stages in the conventional concrete pavement construction. ($7\frac{1}{2}$ marks)

   (c) (i) State **four** functional requirements of joints in rigid pavements.
       (ii) With the aid of a sketch describe a typical expansion joint used in rigid pavements ($8\frac{1}{2}$ marks)

   (d) Describe the **two** components of a pavement surface course stating a function for each. (2 marks)

5. (a) (i) With the aid of a sketch describe the Macadam method of road construction.

       (ii) Outline **three** improvements of the Macadam Method over the Telford construction. (7 marks)

(b)   (i)   With the aid of a sketch describe the laboratory CBR test.

      (ii)   Name the classes of subgrade soils according to Kenyan design standards.   (8 marks)

(c)   State **five** circumstances that would necessitate the use of improved sub-grades.

                                                                        (5 marks)

6.   (a)   State **five** objectives of a site investigation .   (5 marks)

    (b)   (i)   Outline **four** basic requirements for a road alignment.

         (ii)   State **four** details that may be obtained in a reconnaissance survey for a new road.   (10 marks)

    (c)   Explain **two** highway surveys carried out after a reconnaissance survey.   (5 marks)

7.   (a)   State **four** assumptions made in the Westergaard's method of rigid pavement design.   (4 marks)

    (b)   Explain **four** design principles for flexible pavements according to the Kenyan Road Design manual.   (8 marks)

    (c)   (i)   Determine the cummulative number of standard axles for a design period of 15 years, a growth rate of 7.5% per annum for the daily traffic count on a road using the following information and the expression $T = 365t_1 \frac{(1+i)^N - 1}{i}$

Vehicles	No.	Equivalent factors
Buses	30	1
Medium goods vehicles	60	2
Heavy goods vehicles	15	4

         (ii)   Explain the other design steps for the road after determining the cummulative number of standard axles, using the Kenyan design manual. $(5\frac{1}{2}$ marks)

    (d)   State **five** factors considered in the design and construction of road cuttings. $(2\frac{1}{2}$ marks)

8.   (a)   Outline **four** factors considered in the use of rotary intersections.   (6 marks)

    (b)   With the aid of a sketch explain **four** design elements of rotary intersections.   (8 marks)

    (c)   Outline **four** quantifiable benefits a road user gains from a highway improvement scheme.   (6 marks)