2705/201 2709/201
2707/201 2710/201
MATHEMATICS II AND SURVEYING II
June/July 2017
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN BUILDING CONSTRUCTION
DIPLOMA IN CIVIL ENGINEERING
DIPLOMA IN ARCHITECTURE

MODULE II

MATHEMATICS II AND SURVEYING II

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
 Answer booklet;
 Mathematical table/Scientific calculator;
 Drawing instruments.
*This paper consists of **EIGHT** questions in **TWO** sections A and B.*
*Answer **FIVE** questions choosing **TWO** questions from each section and **ONE** other question from either section.*
All questions carry equal marks.
Maximum marks for each part of a question are indicated.
Candidates should answer the questions in English.

This paper consists of 5 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

SECTION A: MATHEMATICS II
*Answer at least **TWO** questions from this section.*

1. (a) Simplify $\dfrac{(2+j3)^2}{(1-j)^2}$, expressing the answer in the form $re^{j\theta}$. (8 marks)

   (b) Solve the equation:
   $z^3 - 3 + j5 = 0$ giving the roots in the form $a + jb$. (12 marks)

2. (a) A closed cylindrical container made of thin metal is to contain a volume of $13\ cm^3$. If the surface area is to be minimum:

   (i) find the expression for the total surface area T; (3 marks)
   (ii) obtain the radius and height of the cylinder. (4 marks)

   (b). Given the function: $f(x,y) = x^6 + 3x^4y^4 + xy^6$, find:

   $$\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial x\,\partial y} - \frac{\partial^2 f}{\partial y\,\partial x}.$$ (8 marks)

   (c) Given that $Z = \sin(x^3 + y^3)$, find the change in Z when x increases by 0.3 while y decreases by 0.2. (5 marks)

3. (a) Find: $\displaystyle\int \frac{(x^2+3)\,dx}{(x+2)(x^2+1)}$. (8 marks)

   (b) (i) Sketch the area enclosed between $y^2 = 3x$ and $y = 3x$. (3 marks)

   (ii) Determine the volume generated by rotating the area in (i) above through $360°$ about the x-axis. (9 marks)

4. (a) The equation of a body performing simple harmonic motion is given by:

   $$\frac{d^2x}{dt^2} + 4x = 0.$$

   Given that when $t = 0$, $x = 5$ and $v = 0$; solve for x. (8 marks)

   (b) A train of mass m kg is moved from rest by an engine which exerts a time dependent force $\frac{1}{3}(1 - e^{-2t})$ on the train. The resistance to motion is given by $R = \frac{1}{5}V$, where V is the speed of the train.

   (i) Write down in terms of V and t the differential equation for this motion. (1 mark)

   (ii) Determine the expression of V in terms of t. (9 marks)

   (iii) Deduce the expression for speed when t becomes large. (2 marks)

SECTION B: SURVEYING II
Answer at least TWO questions from this section.

5. (a) Define the following terms as used in compass surveying:

    (i) bearing;
    (ii) true meridian;
    (iii) magnetic meridian;
    (iv) magnetic declination. (4 marks)

  (b) Convert the following whole circle bearings to reduced bearings:
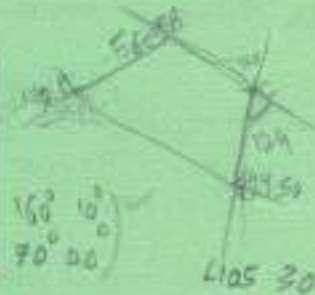
    (i) 65°30';
    (ii) 140°30';
    (iii) 255°10';
    (iv) 336°40'. (6 marks)

  (c) Table 1 shows the observed bearings of lines of a closed compass traverse ABCDA.

Table 1

Line	Forward Bearing
AB	56°10'
BC	129°10'
CD	199°50'
DA	289°20'

    (i) With the aid of a diagram, calculate the interior angles of the traverse.

    (ii) Check on the sum of the resulting angles. (10 marks)

6. (a) State **three** reasons why rectangular coordinates of surveyed points are computed. (3 marks)

  (b) Outline the field procedure of determining the vertical circle index error of a theodolite. (4 marks)

  (c) The following vertical circle readings were taken for the purpose of determining the vertical circle index error.

    Face left (F/L) reading to point A = 09°58'00"
    Face right (F/R) reading to point A = 170°00'20"

  Determine the vertical circle index error of the theodolite. (2 marks)

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(d) An open traverse was run from point A to point E in order to determine the distance and bearing of line AE which could not be directly measured. Using the results of the traverse shown in **table 2**, compute the bearing and distance of line AE.

(8 marks)

Table 2

Line	Bearing	Distance (m)
AB	261°41'00	1025.34
BC	09°06'10"	1087.38
CD	282°22'30"	925.89
DE	71°31'45"	1250.52

(e) Explain the **two** methods of correcting for the effects of local attraction in compass bearings.

(3 marks)

7. (a) With the aid of a diagram, list all the elements of a simple circular curve.

(7 marks)

(b) The following information is for a simple circular curve:

$$\text{Chainage of intersection point} = 60 + 94.72 \text{ m}$$
$$\text{Intersection angle (I)} = 13° 50' 20"$$
$$\text{Degree (D) of curve} = 10°$$
$$\text{Chord length} = 20 \text{ m}$$

Using the information given, compute:

(i) radius of the curve;
(ii) tangent length;
(iii) curve length;
(iv) chainage of 1st and 2nd tangent points;
(v) Length of 1st and 2nd sub-chords;
(vi) 1st and 2nd deflection angles.

(13 marks)

8. (a) Explain how the following errors in Electromagnetic Distance Measuring instruments are caused:

(i) scale error;
(ii) zero error;
(iii) cyclic error.

(5 marks)

(b) **Table 3** shows computed changes in the Northings (ΔN) and Eastings (ΔE) for a traverse run between control points R and P. Use the information and the datum coordinates of R and P to:

(i)   determine the traverse misclosure in linear form;

(ii) adjust the traverse by the transit method;

(iii) determine the final adjusted coordinates of the new traverse points.

closed traverse

(15 marks)

Table 3

Line	$+\Delta N$ (L·sin)	$+\Delta E$ L·cos
R - K1	125.15	33.42
K1 - K2	168.54	138.78
K2 - K3	101.67	83.87
K3 - K4	86.74	82.66
K4 - P	80.08	119.91

Line   angle   Bearing   corrected   Remarks

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