Name:______________________________ Index No.: ____________________

1521/203 1601/203
1522/203 1602/203
MATHEMATICS II
Oct./Nov. 2014
Time: 3 hours

Candidate's Signature:______________

Date:____________________

THE KENYA NATIONAL EXAMINATIONS COUNCIL

CRAFT CERTIFICATE IN ELECTRICAL AND ELECTRONICS ENGINEERING (POWER OPTION) (TELECOMMUNICATION OPTION)

MODULE II

MATHEMATICS II

3 hours

INSTRUCTIONS TO CANDIDATES

Write your name and index number in the spaces provided above.
Sign and write the date of the examination in the spaces provided above.
You should have Mathematical tables/Scientific calculator for this examination.
This paper consists of ***EIGHT*** *questions.*
Answer any ***FIVE*** *questions in the spaces provided in this question paper.*
All questions carry equal marks.
Maximum marks to each part of a question are as shown.
Do ***NOT*** *remove any pages from this question paper.*
Candidates should answer the questions in English.

For Examiner's Use Only

Question	1	2	3	4	5	6	7	8	TOTAL SCORE
Candidate's Score									

This paper consists of 20 printed pages.

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

1\. (a) Solve the equation $2(5^{2x-2})+9(5^{x-1})-5=0$ to three decimal places. (6 marks)

(b) Given the binomial expansion: $(1+ax)^n = 1+\frac{5}{4}x+\frac{5}{8}x^2+\ldots$. Determine:

(i) the values of a and n;

(ii) the coefficient of x^3.

(iii) $(1.025)^5$ using the first **four** terms of the expansion above giving your answer to four decimal places. (10 marks)

(c) The resistance R ohms of a length of wire at t°C is given by $R=R_o(1+xt)$, where R_o is the resistance at 0°C. If $R=30$ ohms at 60°C and $R=32$ ohms at 100°C. Determine x and R_o. (4 marks)

2\. (a) Prove that $\tan\theta+\cot\theta = 2\operatorname{cosec}2\theta$. (3 marks)

(b) (i) Using the expansion of $\tan(A+B)$, show that $\tan 3\theta = \frac{3\tan\theta-\tan^3\theta}{1-3\tan^2\theta}$ (4 marks)

(ii) Hence, solve the equation $\tan 3\theta + 2\tan\theta = 0$ for $0^\circ \le \theta \le 360^\circ$ (5 marks)

(c) A surveyor measures the angle of elevation of the top and bottom of an electric pole as 58° and 34° respectively. If the pole is standing vertically on top of a cliff and the surveyor is 320 metres away from the foot of the cliff, determine the height of the:

(i) cliff;

(ii) pole. (8 marks)

3\. (a) Prove the hyperbolic identities:

(i) $\sinh 3A - 3\sinh 3A = 4\sinh^3 A$;

(ii) $\cosh 2x = 1+2\sinh^2 x$. (10 marks)

(b) If $6e^x + e^{-x} = p\sinh x + Q\cosh x$, determine the values of p and Q. (6 marks)

(c) If $x^3+y^3+3xy^2=8$, find $\frac{\delta y}{\delta x}$. (4 marks)

4. (a) Solve the equation

$$\begin{vmatrix} 1 & 1 & -k \\ k & -3 & 11 \\ 2 & 4 & -8 \end{vmatrix} = 0$$ (8 marks)

(b) The simultaneous equations representing the currents in an electrical network are

$2i_1 - i_2 + 3i_3 = 2$
$i_1 + 3i_2 - i_3 = 11$
$2i_1 - 2i_2 + 5i_3 = 3$

Use inverse matrix method to determine the values of i_1, i_2 and i_3. (12 marks)

5. (a) Given the vectors $\underset{\sim}{A} = 3\underset{\sim}{i} + 2\underset{\sim}{j} - \underset{\sim}{k}$, $\underset{\sim}{B} = \underset{\sim}{i} - \underset{\sim}{j} + k$ and $\underset{\sim}{C} = \underset{\sim}{i} - \underset{\sim}{k}$. Determine:

(i) $\underset{\sim}{A} \cdot \underset{\sim}{B}$

(ii) $|\underset{\sim}{A} \times \underset{\sim}{C}|$

(iii) Angle between $\underset{\sim}{A}$ and $\underset{\sim}{B}$ (9 marks)

(b) If $\underset{\sim}{A} = x^2z\underset{\sim}{i} + xy\underset{\sim}{j} + y^2z\underset{\sim}{k}$ and $\underset{\sim}{B} = yz^2\underset{\sim}{i} + xz\underset{\sim}{j} + x^2z\underset{\sim}{k}$, find grad $(A \cdot B)$ at the point $(1, 2, 1)$. (3 marks)

(c) Given that $\underset{\sim}{A} = x^2y\underset{\sim}{i} + (xy - yz)\underset{\sim}{j} + xz^2\underset{\sim}{k}$ and $\underset{\sim}{B} = yz\underset{\sim}{i} - 4xz\underset{\sim}{j} + 3xy\underset{\sim}{k}$, determine at the point $(1, 3, 1)$:

(i) div $\underset{\sim}{A}$;

(ii) curl $\underset{\sim}{B}$. (8 marks)

6. (a) Differentiate $f(x) = \tan x$ from first principles. (8 marks)

(b) Differentiate the functions with respect to x:

(i) $y = x^2 \tan 2x$;

(ii) $y = \dfrac{x}{\sqrt{1+x}}$. (5 marks)

(c) Determine the height and radius of a cylinder of volume 200 cm³ which has the least surface area. (7 marks)

7. (a) If $z = x\cos y - y\cos x$, show that

$$\frac{\delta^2 z}{\delta x \delta y} = \frac{\delta^2 z}{\delta y \delta x}$$ (4 marks)

(b) The resonant frequency of a series-connected electrical circuit is given by $f = \frac{1}{2\pi\sqrt{Lc}}$ Hz,

where L is the inductance in Henrys and c the capacitance in farads. Use partial differentiation to determine the approximate percentage change in the resonant frequency when L is increased by 1.7 percent and c is reduced by 3.4 percent. (7 marks)

(c) Determine the co-ordinates of the stationary points of the function

$z = x^2 + xy + y^2 + 5x - 5y + 3$ and determine their nature. (9 marks)

8. (a) Evaluate the integrals:

(i) $\int_0^2 (x^3 + 3x^2 + 4x + 2)\delta x$;

(ii) $\int_0^{\frac{\pi}{2}} 5\sin 2x\delta x$. (6 marks)

(b) Given the parametric equation $x = 3\sin\theta - \sin^3\theta$, $y = \cos^3\theta$ find $\frac{\delta^2 y}{\delta x^2}$. (6 marks)

(c) Find the area enclosed by the curves $y = x^2$ and $y^2 = 8x$. (8 marks)