



MURANG'A UNIVERSITY COLLEGE

A constituent college of Jomo Kenyatta University of Agriculture and Technology

University Examination 2014/2015

END OF SEMESTER EXAMINATION FOR THE DIPLOMA IN CIVIL ENGINEERING

SEB 1121 ENGINEERING MATHEMATICS II

DATE: DECEMBER 2015

TIME: 2 HOURS

Instructions: Attempt question **One** and **Two** other questions

QUESTION ONE (30 marks)

- a. Define the term trigonometry **(1mk)**
- b. Solve the following complex numbers for values of a and b
- i. $2(a + bi) = 4 - 3i$ **(2mks)**
- ii. $(i - 2)(i + 1) = a + bi$ (2mks)
- c. Given that $x = 2i + j - k$ and $y = 7i - 2j - 3k$, find the value of $x \cdot y$ **(3mks)**
- d. Find without using tables or calculators the value of
- i. $\tan 150^\circ$ **(4mks)**
- ii. $\sin(60^\circ - 45^\circ)$ **(4mks)**
- e. Find the vector product of the vectors i.e $a \times b$ if $a = i + 3j + 2k$ and $b = 6i - 5j - 4k$ **(5mks)**
- f. Calculate the remaining angles and side of a triangle XYZ in which $x=8\text{cm}$, $z=10\text{cm}$ and angle $Z=80^\circ$. Thereafter calculate the radius of the circum-circle of the triangle A. **(6mks)**
- g. Show that $\frac{\cos a \sin^2 a + \cos^3 a}{\sin a} = \cot a$ **(3mks)**

QUESTION TWO (20 marks)

a. Proof the identity

i. $\sin b \cot b = \cos b$ (2mks)

ii. $\frac{\tan^2 a + 1}{\tan^2 a} = \operatorname{cosec}^2 a$ (3mks)

b. Solve the triangle PQR given that $p=7\text{cm}$, $q=4\text{cm}$ and $R=40^\circ$. (5mks)

c. Given that $\cos A = \frac{4}{5}$ and $\sin B = \frac{15}{17}$ where A and B are acute angles, find without using

trigonometric tables the values of $\cos(A + B)$ and $\sin(A - B)$. [6 Marks]

QUESTION THREE (20marks)

a. Given that $a = i + 2j - 3k$ and $b = 2i + 2j - k$ are vectors find the value of

i. $a * b$ (2mks)

ii. Hence find the angle between vectors a and b (7mks)

b. Without using mathematical tables, find the values of $\sin 15^\circ$ and $\cos 75^\circ$. Leave your answer in surd form. (6mks)

c. Solve the equation $8\sin^2 x + 2\sin x = 1$ for $0^\circ < x < 360^\circ$ (5mks)

QUESTION FOUR (20 marks)

a. Express the following complex number $\frac{1}{1+3i}$ in the form having a real number and a denominator (3mks)

b. Given that $z_1 = i + 4$, $z_2 = 2i + 1$, find the value of z_3 in the form $a + bi$ given that

$$\frac{1}{z_3} = \frac{1}{z_1} + \frac{1}{z_2} \quad (8\text{mks})$$

c. Given that $a = i - 2$ and $b = 2i + 1$ express in the form of $a + bi$ the following complex numbers

i. $a \cdot a$ (4mks)

ii. $\frac{b}{a} - b$ (5mks)

QUESTION 5 (20MKS)

a. Given that $a = 2i - 1$ and $b = i + 6$ are complex numbers, express in the form of $a + bi$ the following complex numbers

i. $b^2 - a^2$

ii.

iii. (4mks)

b. Given that $p = i + 2j - 2k$ and $q = 2i + 3j + k$ are vectors find the value of

i. $p \cdot q$ (3mks)

ii. $p * q$ (4mks)

Hence find the angle between vectors p and q (9mks)