

MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)
University Examinations for 2015/2016 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST SEMESTER EXAMINATION FOR DEGREE IN BACHELOR OF SCIENCE IN
ELECTRICAL AND ELECTRONICS ENGINEERING

SUPPLEMENTARY EXAMINATIONS

ECU 105: ENGINEERING MATHEMATICS I

DATE: 3/8/2016

TIME: 11.00-1.00 PM

INSTRUCTIONS:

Answer Question One and Any Other Two Questions

QUESTION ONE COMPULSORY (30 MARKS)

- a) Given: $A = \{1, 2\}$, $B = \{x, y, z\}$, and $C = \{3, 4\}$. Find: $A \times B$ (4 marks)
- b) Prove that $\sqrt{3}$ is irrational. (5 marks)
- c) If $Z = -5\sqrt{3} - 5i$, find $|z|$ and the argument of Z (4 marks)
- d) Sketch the graph of $g(x) = x^3 - 3x^2 - x + 3$. (4 marks)
- e) i) In the absence of a chairman, a committee of three vice chairmen and four other ordinary members is to sit on a platform. In how many ways can they be arranged if one of the vice-chairman sits in the middle? (2 marks)
- ii) In how many ways can a committee of 4 men and 3 women be formed from 7 men and 8 women? (2 marks)
- f.) Prove the identity $\frac{\cos \theta}{\sqrt{1 + \tan^2 \theta}} + \frac{\sin \theta}{\sqrt{1 + \cot^2 \theta}} = 1$ (3 marks)
- G.) Convert the decimal number system 78 into a binary number system (6 marks)

QUESTION TWO (20 MARKS)

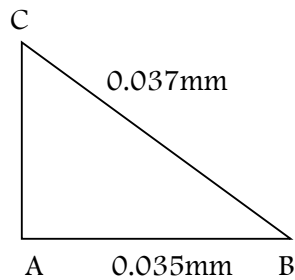
- a) Given that a and b are rational with $b \neq 0$ and s is an irrational number such that $a - bs = t$. Show that t is irrational hence show that $\frac{-1+\sqrt{5}}{1+\sqrt{5}}$ is irrational
(6 marks)
- b) Prove that the set of all integers is countable.
(4 marks)
- c) Perform the calculation of $\frac{\sqrt{3}+i}{(1-i)(\sqrt{3}-i)}$ and express the result in the form $a+bi$
(5 marks)
- d) Find the square root of the complex number $3+4i$
(5 marks)

QUESTION THREE (20 MARKS)

- a) 6 natives and 2 foreigners are seated in the compartment of a railway corridor with seats on each side. In how many ways can the passenger's seat themselves if:
i) the foreigners do not sit opposite each other. (3 marks)
ii) the foreigners do not sit next to each other. (3 marks)
- b) Find the number m of ways that 5 people can arrange themselves around a circular table. (2 marks)
- c) In how many ways can a class of 20 students be divided into 2 groups of 8 and 12, if the class contains one set of twins who must not be separated?
(3 marks)
- d) Solve the equation $\sin 3\theta = 3\sin \theta - 4\sin^3 \theta$ for $0^\circ \leq \theta \leq 360^\circ$.
4marks
- e) Prove that $2\cos \theta \cos 2\theta = \cot \theta - \tan \theta$
5marks

QUESTION FOUR (20 MARKS)

- a) How many committees of three students can be chosen from thirty boys and 22 girls if
(i). exactly three boys must be in each committee ?. (2 marks).
(ii). at least eight girls must be on each committee ?. (3 marks).
- b) Explain what is meant by the following using illustrations;
(i). Complement of a set A (2 marks).
(ii). Disjoint union of sets A and B (3 marks).
- c) Solve the right angled triangle BAC alongside (4 marks)



- d). Let $p = \sqrt{-9}$ and $q = \sqrt{-3}$, find pq (3 marks)

QUESTION FIVE (20 MARKS)

- a). Find the number of combinations of letters of alphabet taken four at a time (4 marks).
- b). Given that $\sin\theta = \frac{12}{13}$, find
- (i) $\sec\theta$ (2 marks).
 - (ii) $\operatorname{cosec}\theta$ (2 marks).
 - (iii) $\cot\theta$ (2 marks).
- c). Prove that $\frac{\cos\theta}{\sqrt{1+\tan^2\theta}} + \frac{\sin\theta}{\sqrt{1+\cot^2\theta}} = 1$ (4 marks).
- d). Show that $\sin 3\theta = 3\sin\theta - 4\sin^3\theta$ (3 marks).
- e). Solve for θ in degrees, in the equation $4\cos^2\theta + 5\sin\theta = 3$ for $0 \leq \theta \leq 2\pi$ (3 marks).