



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FIRST YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONIC ENGINEERING)

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECU 105: ENGINEERING MATHEMATICS II

DATE: 28/1/2022

TIME: 11:00 – 1:00 PM

INSTRUCTION TO CANDIDATES

Answer all questions in section A and any other TWO in Section B

SECTION A (COMPULSORY)

QUESTION ONE (30 MARKS)

- a) Define a complex number and give an example. (2 marks)
- b) If $z_1 = -2 + 3i$ and $z_2 = 3 + 4i$, solve
- i. $z_1 + z_2$ (2 marks)
 - ii. $z_1 - z_2$ (2 marks)
 - iii. $z_1 z_2$ (2 marks)
- c) Find the remainder when $f(x) = x^5 - 4x^3 + 2x + 3$ is divided by $x + 2$ (2 marks)
- d) Simplify the following $\frac{\sqrt{6} + \sqrt{3}}{\sqrt{6} - \sqrt{3}}$ (5 marks)
- e) Solve the equation $\log_5 x + \log_5 (2x - 3) = 1$ (5 marks)
- f) The roots of the equation $3x^2 + 4x - 5 = 0$ are α and β . Find the equation with integral coefficients $\frac{1}{\alpha}$ and $\frac{1}{\beta}$ (5 marks)
- g) Prove the identity below $\frac{\tan \theta + \cot \theta}{\sec \theta + \csc \theta} = \frac{1}{\sin \theta + \cos \theta}$ (5 marks)

SECTION B: ANSWER ANY OTHER TWO QUESTIONS

QUESTION TWO (20 MARKS)

- a) Differentiate between permutations and Combinations. (2 marks)
- b) How many even numbers, greater than 50000 can be formed from the digits 0,3,4,5,6,7.
- i. Without replacement (4 marks)
- ii. If replacement is allowed (4 marks)
- c) When a polynomial $f(x)$ is divided by $(x - 1)$, the remainder is 3. When $f(x)$ is divided by $(x + 1)$, the remainder is 5. When $f(x)$ is divided by $(x - 2)$, the remainder is 20. Find the remainder when $f(x)$ is divided by $(x^2 - 1)(x - 2)$. (10 marks)

QUESTION THREE (20 MARKS)

- a) Write $\log\left(\frac{a^2b^3}{100\sqrt{c}}\right)$ in terms of $\log a$, $\log b$ and $\log c$ (5 marks)
- b) Find the first four terms in the expansion of $\sqrt{1-8x}$ in ascending powers of x . Hence substitute $x = 0.01$ and obtain the value of $\sqrt{23}$ correct to five significant figures. (8 marks)
- c) Prove that $\sin 3\theta = 3\sin \theta - 4\sin^3 \theta$ (7 marks)

QUESTION FOUR (20 MARKS)

- a) Simplify the following surds $(5\sqrt{2} + 3\sqrt{3})(4\sqrt{2} - 5\sqrt{3})$ (5 marks)
- b) Express the complex number $2 + 2\sqrt{3}i$ in polar form and sketch it. (5 marks)
- c) How many different 7-digit telephone numbers are possible if the first digit cannot be zero and no digit may repeat. (5 marks)
- d) Find the coefficients of x^{10} in the expansion of $(2x - 3)^{10}$ (5 marks)

QUESTION FIVE (20 MARKS)

- a) Prove the following identity $\cos 4\theta = 8\sin^4 \theta - 8\sin^2 \theta + 1$ using De'Moivres theorem (10 marks)
- b) Prove that $\sin^{-1} z = \frac{1}{i} \ln\left(iz + \sqrt{1 - z^2}\right)$ (10 marks)