



MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR FIRST SEMESTER EXAMINATIONS FOR
BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)

BACHELOR OF SCIENCE (COMPUTER SCIENCE)

SCO110/SIT190: MATHEMATICAL FOUNDATIONS FOR COMPUTER SCIENCE
/ MATHEMATICAL FOUNDATIONS FOR IT

DATE:

TIME:

INSTRUCTIONS: Answer Question 1 And Any Other 2 Questions.

QUESTION ONE (compulsory) (30 MARKS)

- a) Differentiate between a permutation and a combination. (2 marks)
- b) Simplify the following complex number $i(8p + 4iq)$. (3 marks)
- c) In how many ways can the letters of the word ABRACCADABRA be arranged? (4 marks)
- d) A committee of 10 is to be chosen from nine men and six women. In how many ways can it be formed if at least four women are to be in the committee? (4 marks)
- e) Part of the expansion on $(a + bx)^5$ is $32 + 40x + 20x^2 \dots$. Find the values of the constants a and b . (4 marks)
- f) Express $E = \left((xy)'z \right) (x' + z) (y' + z)'$ as a sum of product expression. (4 marks)
- g) Solve the equation $1 + \cos \theta + 2 \sin^2 \theta$, for the values of θ from 0° to 360° (4 marks)
- h) If $x = \log_9 5$ and $y = \log_3 5$ find y in terms of x . (5 marks)

QUESTION TWO (20 MARKS)

a) Perform the following operations on complex numbers; in each case simplify as far as possible.

i.) $\frac{2-i}{3+2i}$ (2 marks)

ii.) $(4-5i)^2$ (3 marks)

b) Convert the complex number $z = -1 + \sqrt{3}i$ in polar form, hence evaluate the value of z^6 . (5 marks)

c) Rationalize the denominator in $\frac{\sqrt[3]{3}}{\sqrt[3]{9} + \sqrt[3]{7}}$ (5 marks)

d) If the quadratic equation $x^2 - px + q = 0$ has roots α and β , form the equation whose roots are $\frac{\alpha}{\beta^2}$ and $\frac{\beta}{\alpha^2}$ (5 marks)

QUESTION THREE (20 MARKS)

a) Verify that $x-3$ is a factor of the polynomial $f(x) = x^3 - 6x^2 + 11x - 6$ (2 marks)

b) Use De Moivre's theorem to simplify $(1 + i\sqrt{3})^4$ (2 marks)

c) In how many ways can 9 people sit at a round table (2 marks)

d) Simplify $\frac{16!}{9!7!} + \frac{16!}{10!6!} + \frac{16!}{11!5!}$ (3 marks)

e) A committee of 6 people is to be selected from 5 women and 6 men. In how many ways:

i) Can the committee be selected if at least three women must be in the committee? (4 marks)

ii) Can the committee be selected if three men must be in the committee? (3 marks)

f) Find all the cube roots of $-\sqrt{2} + i\sqrt{2}$ (4 marks)

QUESTION FOUR (20 MARKS)

a) Find the remainder when $f(x)$ is divided by $g(x)$ where

i. $f(x) = 3x^3 + 2x^2 - 6x + 1$, $g(x) = x - 2$ (3 marks)

ii. $f(x) = 4x^3 + 6x^2 + 3x + 2$, $g(x) = 2x + 3$ (3 marks)

b) If $z = -2\sqrt{3} - 2i$, find $|z|$ and the argument of z . (4 marks)

c) Show that $\binom{n}{r} + \binom{n}{r-1} = \binom{n+1}{r}$ (4 marks)

- d) Expand $(1 - 5x)^{\frac{1}{3}}$ in ascending powers of x up to and including the term in x^4 . state the range of values of x for which the expansion is valid. Use the expansion to obtain $\sqrt[3]{0.95}$ correct to 4 decimal places (6 marks)

QUESTION FIVE (20 MARKS)

- a) Given that $(x + 1)$ is a factor of the expression $2x^3 + ax^2 - 5x - 2$, find the value of the constant a . (3 marks)
- e) Four men and their wives sit on the bench. In how many ways can they be arranged if
- i) There is no restriction (3 marks)
 - ii) Each man must sit next to his wife. (4 marks)
- f) Solve $z^3 - 1 = 0$, obtaining its three roots. If w is a root not equal to 1, show that the other root may be denoted by w^2 and prove that $1 + w + w^2 = 0$. (10 marks)