



# MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR, FIRST SEMESTER EXAMINATIONS

FOR DIPLOMA IN ENGINEERING. (TVET)

ENGINEERING MATHEMATICS I

DATE:

TIME:

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## INSTRUCTIONS:

The paper consists of **FIVE** questions. Answer all the questions.

Show all your working

1. a) Solve the equations

i)  $\frac{2}{x+2} + \frac{3}{x+3} = 2$

ii)  $2(3^{2x}) - 7(3^x) + 6 = 0$  (11 marks)

b) Solve for x

i)  $4^{3x+1} = 16^{6x-4}$

ii)  $\log(8 - 4x)^{-1} = \log(2x - 4)$  (9 marks)

2. a) Simplify without using tables or calculator

i)  $\sqrt[3]{27x^3y^6} \div \sqrt{\frac{1}{16}x^4y^7} \times (25\sqrt{x^2y^6})^{-1}$

ii)  $\frac{3^3 \times 5^4 + 3^2 \times 5^2}{3^3 \times 5^3}$  (8 marks)

b) Solve for x

$$\log_3 x + 3\log_x 3 = 4 \quad (7 \text{ marks})$$

c) Given that  $3x^2 + 12x + 5 = p(x + q)^2 + r$  (5 marks)

3. a) Simplify the expressions

$$\text{i) } \frac{\log 27 - \frac{1}{2}\log 9}{\log 81 - \frac{1}{2}\log 9}$$

$$\text{ii) } \frac{x(1-x)^{-\frac{1}{2}} + (1-x)^{\frac{1}{2}}}{x^2} \quad (8$$

marks)

b) Prove the identity

$$\frac{\cos \theta}{\sqrt{1+\tan^2 \theta}} + \frac{\sin \theta}{1+\cot^2 \theta} = 1 \quad (5 \text{ marks})$$

c) If  $\sin A = \frac{5}{13}$  and  $\cos B = \frac{4}{5}$  where A and B are acute angles determine

i)  $\cos(A-B)$

ii)  $\cot 2B$  (7 marks)

4.a) solve the equation

$$\cos 2\theta + 3 = 5 \cos \theta \quad \text{for } 0^\circ \leq \theta \leq 360^\circ \quad (8 \text{ marks})$$

b) Solve for x

$$\log_3(2x-1) = -1 \quad (4 \text{ marks})$$

c) Use the method of substitution to solve the simultaneous equations

$$x + 2y + -z = 1$$

$$x + 3y - 2z = 0$$

$$x + y + z = 4 \quad (8 \text{ marks})$$

5.a) Show that  $\log_a b = \frac{1}{\log_b a}$  from first principals (4 marks)

b) Find the value of  $\tan A$  when  $\tan(A-45^\circ) = \frac{1}{3}$  without using tables (5 marks)

c) Solve for  $\theta$  in the equation  $\sec^2 \theta = 3 \tan \theta - 1$  (6 marks)

d) Prove the identity

$$\frac{\tan \theta + \cot \theta}{\sec \theta \operatorname{cosec} \theta} = 1 \quad (5 \text{ marks})$$