

MACHAKOS UNIVERSITY

ECU 105: ENGINEERING MATHEMATICS II

University Supplementary Examinations

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

- a) Find [2 Mks]
 $\log_8 \frac{1}{64}$
- b) Write down the modulus of the complex number $4 - 4i$ expressing the answer in simplest radical form [2 Mks]
- c) Solve each quadratic inequality, and graph the solution on a number line [4 Mks]
 $2x^2 \leq 5x - 2$
- d) Solve the following quadratic equation by using factorization method [4 Mks]
 $6x^2 - 5x = 4$
- e) Solve the equation $\log_2 x^2 = 4 + \log_2 (x - 3)$ [4 Mks]
- f) Evaluate $\sqrt{28} - \sqrt{175} + \sqrt{112}$ [3 Mks]
- g) A group consists of 4 girls and 7 boys. In how many ways can a team of 5 members be selected if the team has [5 Mks]
i. no girls
ii. at least one boy and one girl
- h) The polynomial $f(x)$ is defined by $f(x) = x^4 + 4x^2 + 3x - 7$. By using remainder theorem find the remainder when $f(x)$ is divided by $(x + 3)$ [3 Mks]
- i) If $\tan \theta = \frac{-4}{3}$, find $\sin \theta$ if θ is in the second quadrant [3 Mks]

SECTION B: ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

- a) Simplify $2 \log_3 5 - \log_3 10 + 3 \log_3 4$ [3 Mks]
- b) Solve the following equations by completing the square [4 Mks]
 $3x^2 = 15 - 4x$
- c) How many distinguishable horizontal arrangements are there of the letters in the word **MISSISSIPPI**? [3 Mks]
- d) Find the full binomial expansion of $(1 + 2x)^5$, giving each coefficient as an integer. Hence using a suitable substitution approximate $(1.02)^5$ correct to 5 S.F. [6 Mks]
- e) Simplify the following, leaving your answer in the form $a + bi$ [4 Mks]

$$\frac{3 + 2i}{4 - i}$$

QUESTION THREE (20 MARKS)

- a) Rationalize the denominator of the following [3 Mks]
$$\frac{\sqrt{7}}{2\sqrt{3} - \sqrt{2}}$$
- b) Solve the equation [5 Mks]
 $3^{2x+1} + 9 = 3^{x+3} + 3^x$
- c) The cubic polynomial $f(x)$ is defined by $f(x) = 4x^3 - 7x - 3$
- i) By using remainder theorem find the remainder when $f(x)$ is divided by $(x - 2)$ [2 Mks]
- ii) Show that $(2x + 1)$ is a factor of $f(x)$ and hence factorize $f(x)$ completely. [6 Mks]
- d) Prove that $\frac{\sin 4A + \sin 2A}{\cos 4A + \cos 2A} = \tan 3A$ [4 Mks]

QUESTION FOUR (20 MARKS)

- a) Convert $\frac{7\pi}{6}$ to degrees [1 Mk]

b) Express the following as a sum or difference $\sin 40^\circ \sin 30^\circ$ [4 Mks]

c) Find the exact value of $\cos 75^\circ$ [3 Mks]

d) Express:

i) $2 \sinh x + 3 \cosh x$ in terms of e^x and e^{-x} . [4 Mks]

ii) $\frac{7e^x}{(e^x - e^{-x})}$ in terms of $\sinh x$ and $\cosh x$, and then in terms of $\coth x$ [5 Mks]

e) Calculate $\left\{ 2 \left(\cos \frac{\pi}{5} + i \sin \frac{\pi}{5} \right) \right\}^5$ [3 Mks]

QUESTION FOUR (20 MARKS)

a) Solve the equation $12 \cos^2 \theta + \sin \theta = 11$ on the domain $0^\circ \leq \theta \leq 360^\circ$ [7 Mks]

b) Simplify the following trigonometric expressions [4 Mks]

$$\frac{2 \sin^2 \theta + \sin \theta - 3}{1 - \cos^2 \theta - \sin \theta}$$

c) Find the conjugate, modulus and argument of $z = 5 + 3i$ [5 Mks]

d) Find angle A, angle B and length a if triangle ABC is given as $C=40^\circ$, $b=23\text{cm}$ and $c=19\text{cm}$

[4 Mks]