



MACHAKOS UNIVERSITY

University Examinations 2020/2021 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR SPECIAL /SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECU 105: ENGINEERING MATHEMATICS II

DATE: 23/3/2021

TIME: 8.30-10.30 AM

INSTRUCTION:

ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS

QUESTION ONE (30 MARKS)

- a) Find (2 marks)
- $$\log_8 \frac{1}{64}$$
- b) Write down the modulus of the complex number $4 - 4i$ expressing the answer in simplest radical form (2 marks)
- c) Solve each quadratic inequality, and graph the solution on a number line (4 marks)
- $$2x^2 \leq 5x - 2$$
- d) Solve the following quadratic equation by using factorization method (4 marks)
- $$6x^2 - 5x = 4$$
- e) Solve the equation $\log_2 x^2 = 4 + \log_2 (x - 3)$ (4 marks)
- f) Evaluate $\sqrt{28} - \sqrt{175} + \sqrt{112}$ (3 marks)

- 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 marks)
- no girls
 - 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 marks)
- i) If $\tan \theta = \frac{-4}{3}$, find $\sin \theta$ if θ is in the second quadrant (3 marks)

QUESTION TWO (20 MARKS)

- a) Simplify $2 \log_3 5 - \log_3 10 + 3 \log_3 4$ (3 marks)
- b) Solve the following equations by completing the square (4 marks)
- $$3x^2 = 15 - 4x$$
- c) How many distinguishable horizontal arrangements are there of the letters in the word **MISSISSIPPI**? (3 marks)
- 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 marks)
- e) Simplify the following, leaving your answer in the form $a + bi$ (4 marks)
- $$\frac{3 + 2i}{4 - i}$$

QUESTION THREE (20 MARKS)

- a) Rationalize the denominator of the following (3 marks)
- $$\frac{\sqrt{7}}{2\sqrt{3} - \sqrt{2}}$$
- b) Solve the equation (5 marks)
- $$3^{2x+1} + 9 = 3^{x+3} + 3^x$$
- c) The cubic polynomial $f(x)$ is defined by $f(x) = 4x^3 - 7x - 3$
- By using remainder theorem find the remainder when $f(x)$ is divided by $(x - 2)$ (2 marks)

- ii. Show that $(2x+1)$ is a factor of $f(x)$ and hence factorize $f(x)$ completely. (6 marks)
- d) Prove that $\frac{\sin 4A + \sin 2A}{\cos 4A + \cos 2A} = \tan 3A$ (4 marks)

QUESTION FOUR (20 MARKS)

- a) Convert $\frac{7\pi}{6}$ to degrees (1 mark)
- b) Express the following as a sum or difference $\sin 40^\circ \sin 30^\circ$ (4 marks)
- c) Find the exact value of $\cos 75^\circ$ (3 marks)
- d) Express:
- $2 \sinh x + 3 \cosh x$ in terms of e^x and e^{-x} . (4 marks)
 - $\frac{7e^x}{(e^x - e^{-x})}$ in terms of $\sinh x$ and $\cosh x$, and then in terms of $\coth x$ (5 marks)
- e) Calculate $\left\{ 2 \left(\cos \frac{\pi}{5} + i \sin \frac{\pi}{5} \right) \right\}^5$ (3 marks)

QUESTION FIVE (20 MARKS)

- a) Solve the equation $12 \cos^2 \theta + \sin \theta = 11$ on the domain $0^\circ \leq \theta \leq 360^\circ$ (7 marks)
- b) Simplify the following trigonometric expressions (4 marks)
- $$\frac{2 \sin^2 \theta + \sin \theta - 3}{1 - \cos^2 \theta - \sin \theta}$$
- c) Find the conjugate, modulus and argument of $z = 5 + 3i$ (5 marks)
- 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 marks)