MACHAKOS UNIVERSITY

University Examinations for 2024/2025 Academic Year

SCHOOL OF ENGINEERING

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIRST YEAR FIRST SEMESTER EXAMINATION FOR DEGREE IN BACHELOR OF SCIENCE (MECHANICAL ENGINEERING) BACHELOR OF SCIENCE (ELECTRICAL ENGINEERING) BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECU 105: ENGINEERING MATHEMATICS II
ECU 111: ALGEBRA FOR ENGINEERS

DATE: 17TH JANUARY, 2025 **TIME: 11.00 AM – 1.00 PM**

INSTRUCTIONS:
*Answer question **ONE (Compulsory)** and **any other TWO** questions*

QUESTION ONE (30 MARKS)

a) State Osborn's rule of hyperbolic functions (2marks)

b) Evaluate correct to 5 significant figures

i) $5(\frac{e^{0.25}-e^{-.0.25}}{e^{0.25}+e^{-0.25}})$ (2marks)

ii) ${}^{28}C_{12}$ (1mark)

iii) ${}^{13}P_{2}$ (1mark)

c) Solve for the unknown in the inequality;

$$\frac{5x+7}{x+2} \leq 20$$ (3marks)

d) Simplify the following logarithm

$$\frac{\frac{1}{2}\log 16-\frac{1}{3}\log 8}{\log 4}$$ (3marks)

e) Express in surd form and simplify by rationalizing the denominator

$$\frac{1+\cos 30^0}{1-\sin 60^0}$$ (3marks)

f) Without fully expanding $(1+x)^3$ determine the fifth term (3marks)

g) Determine in polar form $[3<11^3]^4$ (1mark)

h) Evaluate $\frac{2^2\times 4^5}{2^4\times 3^4+3^3\times 5^3}$ (3marks)

i) 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 $x+3$ (3marks)

j) A cyclist travels to his uncle's home 30km away from his place. He cycles for two thirds of the journey before the bicycle develops mechanical problems and he has to push it for the rest of the journey. If his cycling speed is 10km/h faster than his walking speed and he completes the journey in 3hours 20minutes, determine his cycling speed. (5marks)

QUESTION TWO (20 MARKS)

a) State De Moivre's theorem (2marks)

b) Determine in polar form

i) $\left[4<62^0\right]^9$ (2marks)

ii) $(-5+j7)^8$ (3marks)

iii) $(-16+j9)^{17}$ (3marks)

c) Determine the two square roots of the complex number $(17+j3)$ in polar and Cartesian forms and show the roots on an Argand diagram.

(10marks)

QUESTION THREE (20 MARKS)

a)

i) Determine the value of $12e^{0.09}$ correct to 8 significant figures using the power series for e^x (5marks)

ii) Expand $e^x(x^3-1)$ as far as the term x^7 (6marks)

b) Draw the graph of $y=-3+x-x^2$, use it to estimate the roots of this quadratic function (9marks)

QUESTION FOUR (20 MARKS)

a) Reduce the following to the sine of one angle

i) $\sin 37 \cos 21 + \cos 37 \sin 21$ (4marks)

ii) $\cos 3t \sin 7t - \cos 7t \sin 3t$ (4marks)

b) Solve the equations;

i) $2\,\text{Cosh}\, 2x + 10\,\text{Sinh}\, 2x = 5$ (7marks)

ii) $\text{Sinh}\, x = \frac{3}{4}$ (5marks)

QUESTION FIVE (20 MARKS)

a) Solve the following;

i) $9C_6$ (2marks)

ii) $13P_2$ (2marks)

b) Determine using Pascal's triangle method the expansion $(2a + 3b)^{12}$ (5marks)

c) Use binomial series to determine the expansion of $(2 + y)^8$ (4marks)

d) State the Remainder theorem. (2marks)

e) Express $6x^2 + 2n - 3$ in the form $(2x - 2)Q(x) + R$ where Q(x)and R are to be found

(5marks)