MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING, APPLIED SCIENCES AND TECHNOLOGY

DEPARTMENT OF MINING AND MINERAL PROCESSING ENGINEERING
DEPARTMENT OF CHEMICAL AND PROCESSING ENGINEERING

MODULE: ENGINEERING MATHEMATICS I

CODE: ENGT 102

SESSIONAL EXAMINATIONS
DECEMBER 2023

DURATION: 3 HOURS

EXAMINER: NYAKUAMBA T

INSTRUCTIONS

1. Answer **All** in Section A
2. Answer **three** questions in Section B.
3. Start a new question on a fresh page
4. Total marks 100

Additional material(s): *Non-programmable electronic scientific calculator.*

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SECTION A (40 marks)

Answer ALL Questions

A1. a) You told that $\pi = \frac{22}{7}$, is this true or false. Give a reason for your answer.

[3]

b) Find the values of x for which the functions

(i) $\frac{4x-3}{x(x+4)(2x-9)}$

(ii) $\frac{1+cosx}{1-sinx}$

Are not defined. [3,2]

A2 Let $f(x) = (x-2)(8-x)$ for $2 \le x \le 8$

(a) Find $f(6) \, and \, f(-1)$. [3]
(b) Determine the nature of the turning points and sketch the curve. [5]

A3 (a). A farmer has an adjustable electric fence that is 100m long. He uses it to enclose a rectangular grazing area on three, the fourth side being a fixed hedge. Find the maximum area he can enclose. [5]

(b) differentiate $\frac{1}{x^2}$ from the first principals. [3]

A4. Differentiate the following functions with respect to x

(i) $f(x) = x^2 - \frac{1}{\sqrt{x}} + lnx$ [2]
(ii) $x^2 - xy + y^2 = 0$ [3]

(iii) $x = cos2t; \quad y = sin2t$ [3]

A5) Find the set of valves of x for which the following set of inequalities hold

(a)$x^2 \geq 5x - 6$ [4]

(b)$\dfrac{1}{x-2} > \dfrac{2}{x+3}$ [4]

SECTION B. (60 Marks)
Candidate may attempt three questions being careful to number them B6 to B9

B6.(i) Evaluate the following limits

a) $\lim\limits_{n \to \infty} \dfrac{3n^3 + n - 2}{2n^3 - n^2 + 6}$ [3]

b) $\lim\limits_{n \to \infty} (\dfrac{n+2}{3n-5})^3$ [3]

c) $\lim\limits_{n \to 0} \dfrac{sinx}{x}$ [2]

d) $\lim\limits_{n \to \infty} (\sqrt{n + 10} - \sqrt{n})$ [4]

(ii)Solve the following equations

(a)$|3 + 2x| = 2|x + 1|$ [4]

(b)$\dfrac{2}{7x} - \dfrac{4}{3x} > 1$ [4]

B7(a) Differentiate the following functions with respect to x

(i) $y = 3x^2 + 2x + 7 + e^{3x^2 - 3x + 6}$ [4]

(ii) $y = \dfrac{e^x}{e^x - e^{-x}}$ [4]

(iii) $y = \dfrac{1}{x^2}$ [2]

b)Integrate the following functions with respect to x.

i) $\dfrac{Cos\ x - Sin\ x}{Sin\ x + Cos\ x}$

ii) $3e^{-3x} - \dfrac{1}{2}e^{2x}$

iii) $x^2 e^x$

iv) lnx

B8 a) *Find the area of the bounded plane R lying between   the curves*
$y = x^2 - 4x$ *and* $y = 4 - x^{2.}$ [5]

b) Given that $x = 3(2\theta - 3Sin\ 2\theta)$ and $y = 3(1 - Cos\ 2\theta)$

Find $\dfrac{dy}{dx}$ [5]

c)Find the equation of the tangent to the curve
    $3x^2 - 7y^2 + 4xy - 8x = 0$ at the point$(-1,1)$.   [5]

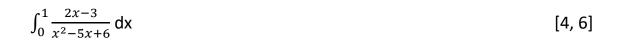d)(i) Define cosh x and sinhx in terms of exponentials.

(ii)Using the definition in (i) above show that

$\dfrac{d}{dx}\cosh(x) = \sinh(x)$ [5]

B 9. (a) Prove by induction that

$\sum_{r=1}^{n} r^2 = \dfrac{n}{6}(n+1)(2n+1)$ for all $n \in \mathcal{R}$ [7]

(b) (i) Integrate $x^2 e^x$ with respect to x   [3]

(ii) Express $\dfrac{2x-3}{x^2-5x+6}$ in partial fractions hence or otherwise

$$\int_0^1 \frac{2x-3}{x^2-5x+6} \, dx \qquad \qquad [4, 6]$$

END OF QUESTION PAPER