MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING, APPLIED SCIENCES & TECHNOLOGY

DEPARTMENT OF MINING & MINERAL PROCESSING ENGINEERING
DEPARTMENT OF CHEMICAL & PROCESSING ENGINEERING
DEPARTMENT OF METALLURGICAL ENGINEERING
ENGINEERING MATHEMATICS I

CODE: ENGT 102

SESSIONAL EXAMINATIONS
APR 2024
DURATION: 3 HOURS
EXAMINER: MR T.NYAKUAMBA

INSTRUCTIONS

1. *Answer **All questions** in Section A*
2. *Answer any **three(3)** 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,*

SECTION A (40 marks)

Answer ALL Questions

A1) (a) Does the decimal number 0.12345678910111213141516171819…
represents a rational or an irrational number? Give a reason for your answer. [3]

    (b) For what values of x is each of the following functions continuous

    (i) $f(x) = \dfrac{x^2}{x^2-1}$;   [2]

    (ii) $f(x) = \dfrac{1+cosx}{3+sinx}$;   [1]

    (iii) $f(x) = \dfrac{x-|x|}{x}$.   [2]

A2 (a) Write down the first four terms 0f each of the following sequences:

    (i) $u_n = \dfrac{6n-7}{4n+3}$;   [2]

    (ii) $s_n = \dfrac{(-1)^{n-1}}{n^4}$.   [2]

    b) For each of the following sequences find a possible formula for u_n

    (i) $1, \dfrac{1}{8}, \dfrac{1}{27}, \dfrac{1}{64}, \dots$;   [2]

    (ii)   2, 5, 10, 17, 26, … .   [2]

A3) If x= -4, y=10, z=3

    P=2/3, q=5/4 and r=-4/5

    (a) Evaluate:

    (i) (x+y)+z ;

    (ii) x+(y+z) .   [2]

    (b) Evaluate

    (i) (pq)r;

(ii) p(qr) .   [2]

(c) which law is illustrated by 3 (a) and 3 (b)   [2]

(d) You are told that π=22/7 is this true or false. Give reason for your answer. [2]

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)$2x^2 - 3x - 5 \geq 0$;

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

SECTION B. (60 Marks)
Candidates must attempt any three questions being careful to number
them B6 to B9

B6) (i) Evaluate the following limits:

a) $\lim_{n\to\infty} \frac{n^2+n}{n^3-n^2}$;   [2]

b) $\lim_{n\to\infty} (\frac{n+2}{3n-5})^3$;   [2]

c) $\lim_{x\to0} \frac{sinx}{x}$;   [2]

d) $\lim_{x\to5} 3$;   [2]

e) $\lim_{n\to\infty} (\sqrt{n+10} - \sqrt{n})$.   [4]

(ii)Solve the following equations

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

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

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

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

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

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

b) Integrate the following functions with respect to x:

i) $\frac{Cos\,x-Sin\,x}{Sin\,x+Cos\,x}$;

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

iii) $(3x + 5)^5$;

iv) $Cos(6 - 7x)$.   [10]

B8 (a) If $x^2 y = a\ Cos\ nx$.

 Show that;

$$x^2 \frac{d^2y}{dx^2} + 4x\frac{dy}{dx} + n^2(x^2 + 2)y = 0 \ .$$ [6]

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

    Find $\frac{dy}{dx}$.   [6]

  (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 sinh x in terms of exponentials.

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

$$\frac{d}{dx}\cosh(x) = \sinh(x) \ .$$ [3]

B 9. (a) Prove by induction that

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

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

    (ii) Express $\frac{2x-3}{x^2-5x+6}$ in partial fractions. Hence or otherwise
    $\int_{0}^{1} \frac{2x-3}{x^2-5x+6}$ dx   [4,6]

END OF QUESTION PAPER