THE PRESIDENT'S OFFICE

REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT

FORM SIX COMPETENCE EXAMINATIONS (FOSCE) - 2025

CODE: 142/1 **ADVANCED MATHEMATICS 1**

TIME: 3 HOURS **20TH FEBRUARY 2025, AM**

INSTRUCTIONS:

1. This paper consists of **ten (10)** questions and each question carries **10 marks**.
2. Answer **ALL** questions
3. All working must be shown clearly on how you arrived at the answer.
4. NECTA's mathematical tables and non-programmable calculators may be used
5. Cellular phones are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklets.

1. (a) Use a non-programmable scientific calculator to evaluate each of the following expressions (give the answer correct to the stated number of decimal places or significant figures):

(i) $6\left(\frac{e^{0.3}-e^{-0.3}}{e^{0.3}+e^{-0.3}}\right)\times\left(\frac{3.946\times e^{\ln 2.67}}{\log 10^{1.5}}\right)^{\frac{1}{3}}$ (to four decimal places).

(ii) $\frac{\sqrt[3]{0.5677}}{\pi\sec^{-1}(2.34)+\sqrt{5.7\times10^{-2}}}$ (to 3 significant figures)

(b) If $\tan\beta=\frac{14.32\times\tan 20^{0}36'45''}{78.90\times\cos 17^{0}5'37''}$,

Use a non-programmable scientific calculator to determine the value of β in the following forms:

(i) In degree, correct to 2 decimal places.
(ii) In radian, correct to 4 decimal places.

2. (a) By using the definition of $coshy$ and $sinhy$ show that $2y=\ln\left(\frac{coshy+sinhy}{coshy-sinhy}\right)$

(b) Show that $\sqrt{\frac{1+tanh2\theta}{1-tanh2\theta}}=cosh2\theta+sinh2\theta$

(c) Evaluate $\int\frac{dx}{\sqrt{x^2+6x+5}}$

3. Twiga and Tembo cement company has two depots A and B with capacities of $7000tones$ and $4000tones$ of cement respectively. The company has to supply the cement to three customers $C_1, C_2\ and\ C_3$ whose requirements are $4500\ tones, 3000\ tones\ and\ 3500\ tones$ of cement respectively. The distance (in km) between the depots and customer's stations are described in the table:

From /To	A	B
C_1	7	3
C_2	6	4
C_3	3	2

Assuming the transportation cost of $100kg\ is\ 1000Tsh\ per\ kilometer$

(a) How should the delivery be scheduled in order that the transportation cost is minimum?
(b) Calculate the minimum cost.

4 (a) In statistics lesson 12 people were asked to think of a number x between 1 and 20 inclusive. From the result Barack found that $\sum x=186$ and that of standard deviation of $x\ is$ 4.5. assuming that Barack's calculations are correct, find the values of

(i) $\sum(x-10)$
(ii) $\sum(x^2-10)$

(b) The masses of the sample of new potatoes were measured to the nearest gram and summarized in the following table:

Mass(g)	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
Frequency	2	14	21	73	42	13	9	4	2

Determine the following measures of dispersion correct to three decimal places

(i) Semi-interquartile range
(ii) 80^{th}percentile
(iii)$Variance\ and\ standard\ deviation$

5. (a) Using set properties, simplify $\big(An(AUB)\big)U(B^cnA^cUB^c))$

(b) Mlandizi social Training College Cultural group consists of 36 villagers, 25 of them participate in dancing, 28 participate in singing, while 26 among them participate in drama, 19 villagers dance and sing, 18 villagers dance and play drama and 15 participate in all three activities. If each villager participates in at least one of the activities, use Venn diagram to find the number of villagers;

(i) Who are either dancing or playing drama,

(ii) Who participate in at most two activities?

(iii)Who are neither playing drama nor singing?

6. (a) Find the function $g(x)$ such that $gof(x) = h(x)$ if $f(x) = x + 4$ and $h(x) = 4x - 1$

(b) Sketch the graph of $f(x) = \frac{3x+3}{-x^2+3x}$, hence state the domain and range of $f(x)$.

(c) The tables give some selected ordered pairs of functions f and g

x	2	7	1	9
g(x)	3	6	9	12

x	3	4	6	10
f(x)	1	3	9	20

Find each of the following;

(i) $fog(2)$
(ii) $gof(3)$

7. (a) Show that there is a root exists between 3.0 and 3.5 in a curve $lnx = x - 2$.

(b) By using Newton Raphson Method with three iterations approximate the reciprocal of the age of a university student who had 24 years to four decimal places.

(c) Evaluate$\int_0^1 \frac{dx}{2+2x^2}$, correct to four significant figures using

(i) The trapezoidal and Simpson's rules with eleven ordinates.

(ii) The analytical method, hence give reasons which rule is more accurate.

8. (a) Find the value of t if the angles between the lines $4x - y + 7 = 0$ and $tx - 5y - 9 = 0$ is 45^0

   (b) A point P lies on the circle of radius 2 whose Centre is at the origin. If A is the point $(4, 0)$, find the locus of a point which divides AP in the ratio 1:2.

9 (a) Find $\int \frac{dx}{(x-1)^2(x^2+1)}$

   (b) Integrate $\int \frac{dx}{cos^3 x}$

   (c) Determine the area of the region enclosed by the curve $y = x^2$, $y = 4x - x^2$ *and* the x-axis

10 (a) From the first principle, differentiate $y = cotx$.

   (b) Use Maclaurian's theorem to find an expansion of $e^x sinx$ as far as the term x^4

   (c) The length x of a rectangle is decreasing at the rate of $5\,\text{cm/minute}$ and the width y is increasing at the rate of $4\,\text{cm/minute}$. when $x = 8\,\text{cm}$ and $y = 6\,\text{cm}$. Find the rates of change of
   (i) The perimeter and
   (ii) The area of the rectangle.