

**KENYA POLYTECHNIC UNIVERSITY COLLEGE**

**SCHOOL OF HEALTH SCIENCES AND TECHNOLOGY**

**DEPARTMENT OF COMMUNITY AND PUBLIC HEALTH**

**DIPLOMA IN COMMUNITY AND PUBLIC HEALTH**

**END OF STAGE 2 EXAMINATION**

**NOVEMBER 2011**

**NUMERICAL METHODS**

**TIME 2 HOURS**

**Instructions to candidates**

1. You should have the following for this examination
  - Electronic calculator
  - Official answer booklet
2. The paper consists of FIVE questions each out of 20 Marks.
3. Attempt FOUR questions out of FIVE questions
4. The maximum marks for each part of a question are as shown
5. Show all your working neatly

**This paper consists of 3 printed pages**

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1 a) Tabulate the function  $f(x) = \frac{1}{1+x}$  Over 0 [0.5]3

Hence apply the interpolation and extrapolation methods to approximate, correct to three decimal places.

- i)  $f(1.26)$
- ii)  $f(3.25)$  (9 Marks)

b) Table 1

|      |    |    |    |   |   |   |    |
|------|----|----|----|---|---|---|----|
| x    | -3 | -2 | -1 | 0 | 1 | 2 | 3  |
| f(x) | 11 | 6  | 3  | 2 | 3 | 6 | 11 |

Develop a table of finite differences for Table 1. Hence determine the function f(x) and solve f(x) = 0 (11 Marks).

2. a) Evaluate

$$\frac{dx}{2+x} \quad (4\text{Marks})$$

b) Use the Trapezoidal rule with 7 ordinates to approximate  $\frac{dx}{2+x}$

Hence calculate the percentage error in your approximated value (16 Marks)

3 a) One root to the equation  $x^3 - 2x + 1 = 0$  is  $x = 1$ . obtain, in surd form, the other two remaining roots (6 Marks)

b) Formulate FIVE possible iterative formulae to solve the equation:  
 $x^3 - 2x + 1 = 0$  (8 Marks)

c) Starting with  $x_1 = 0.5$ , through three iterations, determine the better root to  $x^3 - 2x_n + 1 = 0$ , using the formula

$$x_{n+1} = \frac{2x_n^3 - 1}{3x_n^2 - 2} \quad (6\text{ Marks})$$

4. Table 2

|      |   |       |     |       |     |        |      |        |      |
|------|---|-------|-----|-------|-----|--------|------|--------|------|
| x    | 0 | 0.5   | 1.0 | 1.5   | 2.0 | 2.5    | 3.0  | 3.5    | 4.0  |
| g(x) | 1 | 0.125 | 0.0 | 1.375 | 3.0 | 11.625 | 22.0 | 36.875 | 57.0 |

One functional value in Table 2 is wrongly recorded.

a) Use finite differences to correct the wrongly recorded value (10 Marks)

b) Apply the Newton – Gregory formula to determine

- i)  $f(0.582)$
- ii)  $f(4.15)$  (10 Marks)

5. a) Evaluate  $\int (x^2 - 2x + 1) dx$

(3 Marks)

b) Use the Simpson's rule with 9 ordinates to estimate the area bounded by the ordinates  $x = 0$ ,  $x = 3$ , the line  $y = 0$  and the curve given by the equation  $y = x^2 - 2x + 1$ . Hence, using the result in 5 a), calculate the percentage error in the estimated area

(17 Marks)