



# THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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**MAIN EXAMINATION**

**JANUARY – APRIL 2018 TRIMESTER**

**FACULTY OF SCIENCE**

**DEPARTMENT OF MATHEMATICS AND ACTUARIAL SCIENCE**

**PART TIME PROGRAMME**

**MAT 501: METHODS OF APPLIED MATHEMATICS I**

**Date: APRIL 2018** **Duration: 3 Hours**

**INSTRUCTIONS: Answer Question ONE and any other TWO Questions**

- Q1. a) Find the derivative  $\frac{dy}{dx}$  at  $x = 1$  using the forward difference method for the table of values bellow; **7 marks**

x	1	2	3	4
y	1	8	27	64

- b) The velocity of a particle which starts from rest is given by the following table:

t (sec)	0	2	4	6	8	10	12	14	16	18	20
v (m/sec)	0	16	29	40	46	51	32	18	8	3	0

Evaluate using the trapezium rule, the total distance travelled in 20 seconds.

**6 marks**

- c) Evaluate the double integral  $\int_0^2 \int_0^2 (x, y) dx dy$ , by the trapezium rule for the following data; **10 marks**

$y/x$	0	0.5	1.0	1.5	2.0
0	2	3	4	5	5
1	3	4	6	9	11
2	4	6	8	11	14

- d) Given that  $f(0) = 1, f(1) = 3, f(3) = 55$ , use the Lagrange interpolation polynomial to find the unique polynomial of degree 2 or less, which fits the given data. **7 marks**
- Q2. a) Using the operator relations, derive the approximations to the derivatives  $f'(x_0)$  and  $f''(x_0)$  in terms of forward differences. **6 marks**
- b) Evaluate the integral  $I = \int_1^2 \frac{2x}{1+x^4} dx$ , using Gauss one point, two and three point rules and compare with the exact solution  $I = \tan^{-1}(4) - \left(\frac{\pi}{4}\right)$  for errors. **14 marks**
- Q3. The following data represents the function  $f(x) = e^{2x}$ . Using the forward difference and the entire data, compute;
- (a) (i) the approximation to  $f'(0.3)$  **6 marks**  
(ii) find the first order and second order approximations to  $f'(0.3)$ . **7 marks**
- (b) (i) the approximation to  $f''(0.3)$  using the entire data and the first order approximation. **6 marks**  
(ii) the magnitudes of actual errors in each case. **1 marks**

x	0.0	0.3	0.6	0.9	1.2
f(x)	1.0000	1.8221	3.3201	6.0496	11.0232

- Q4. a) The following data gives the velocity of a particle for 8 seconds at an interval of 2 seconds. Find the initial acceleration using the entire data. **8 marks**

Time (sec)	0	2	4	6	8
Velocity (m/sec)	0	172	1304	4356	10288

- b) Find  $f'(3)$  and  $f''(3)$  using the following table of values; **12 marks**

x	3.0	3.2	3.4	3.6	3.8	4.0
f(x)	-14	-10.032	-5.296	-0.256	6.672	14

- Q5. a) Find the approximate value of  $I = \int_0^1 \frac{dx}{1+x}$ , using the trapezium rule with 2, 4, 8 Equal intervals. **17 marks**
- b) Using the exact solution in (a), find the absolute errors. **3 marks**

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