**Machakos University College**
**(A Constituent College of Kenyatta University)**
**UNIVERSITY EXAMINATIONS 2013/2014**
**SCHOOL OF COMPUTING AND APPLIED SCIENCES**
**SECOND YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE**
**SCO 213: NUMERICAL ANALYSIS**

**DATE**: 8/3/2014 **TIME:** 8.30 a.m. – 10.30 a.m.

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***INSTRUCTIONS:***

*Answer question **ONE** which is Compulsory and any other **TWO** questions*

**Question One (Compulsory)**

(a) The true values of two quantities x and y are 4.00 and 1.00 respectively. If their computed values are 4.04 and 1.02 respectively determine the absolute error, relative error and percentage error in their product. (5 marks)

(b) The function $f(x) = e^x cosx$ is evaluated at $x = 1$. Find the error in $f(x)$ if the x used in the computation has an error of 0.01. (5 marks)

(c) A function takes on the following values:-
$f_0 = 0, f_1 = 41, f_2 = 79, f_3 = a, f_4 = 146.$

(i) Express $\Delta^4 f_0$ using functional values $f_0, f_1, f_2, f_3, f_4$, where $\Delta$ is the forward difference operator. (3 marks)

(ii) If $\Delta^4 f_0 = 0$ use the expression in (i) above and the values of the function given to find the value of a. (i.e. $f_3$). (2 marks)

(d) Construct a backward difference table for $f(x) = x^2 - 3x^2 + 5x - 7 \; for \; x = -1, 0, 1, 2, 3, 4, 5.$ (5 marks)

(e) By letting h be the interval of differencing show that $\left(\frac{\Delta^2}{E}\right) x^3 = 6xh$ (4 marks)

(f) Use the trapezium rule to estimate the area from x = 0.2 to x = 1 for the curve $f(x) = x^2 + x$ using $n = 4$ (6 marks)

**Question Two**

(a) A function takes the following values shown in the table below:

| x | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| f(x) | 5 | 6 | 13 | 32 | 69 | 130 | 221 |

(i) Construct a forward difference table for the function. (7 marks)
(ii) Using the constructed table find f(7) and f(8). (4 marks)

(b) Given a function f(x) such that f(0) = -3, f(1) = -5, f(3) = 18. Find the 2 – degree lagrange interpolating polynomial. (9 marks).

**Question Three**

(a) Evaluate $\int_0^{12} \frac{1}{1+x^2} dx$ by using Simpson's ⅓ rule taking n = 6. (8 marks)

(b) Find the exact value of $\int_0^{12} \frac{1}{1+x^2} dx$ and compute the percentage error introduced in (a) above. (5 marks)

(c) Use Newton-Raphson method to find the real root near o of the equation $x^2 + x - 5 = 0$ to 2d.p. (7 marks)

**Question Four**

(a) Given that Δ is the forward difference operator and ∇ is the backward difference operator, show that $(1+\Delta)(1-\nabla) = 1$ (4 marks)

(b) Relate the shift operator E to the differential operator D starting with a taylor series using h as the step size. (12 marks)

(c) Using (b) above deduce the relationship between the operator Δ and D. (4 marks)

**Question Five**

(a) Use the bisection method to determine the root of $f(x) = e^{-x} - x$ giving your answer to 4 decimal places. (10 marks)

(b) Apply lagranges interpolation formula to find apolynomial which passes through the points (0, -20) (1, -12) (3, -20) and (4, -24). (10 marks)