MERU UNIVERSITY COLLEGE OF SCIENCE & TECHNOLOGY
P.O. Box 972-60200 Meru - Kenya. Tel: 020-2092048, 020 2069349
Fax: 020-8027449

University Examinations 2012/2013

SECOND YEAR, SECOND SEMESTER, EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE

ICS 2207: SCIENTIFIC COMPUTING

DATE: DECEMBER 2012 **TIME: 2 HOURS**

INSTRUCTIONS: *Answer question **one** and any other **two** questions*

QUESTION ONE – 30 MARKS

a. Given a=0.555E01, b=0.4545E01 and c=0.435E01, find a(b – c) using **normalized floating point** with a 6 bit hypothetical computer in which 4 bits are reserved for mantissa and two bits are reserved for exponent.

(2 Marks)

b. Differentiate between an overflow and an underflow by using appropriate examples in computer arithmetic. (2 Marks)

c. By using **Lagrange Polynomial,** fit a **second order** interpolating polynomial for the data given below:

x	2	4	5
F (x)	0.5	0.25	0.2

Hence find the value of F(x) at x = 3 (4 Marks)

d. Find the **LU decomposition** of the matrix A below. (5 Marks)

$$A = \begin{pmatrix} 2 & 3 & 5 \\ 3 & 4 & 1 \\ 6 & 7 & 2 \end{pmatrix}$$

Hence or otherwise solve the simultaneous equations below: (3 Marks)

$2x + 3y + 5z = 23$

$3x + 4y + z = 14$

$6x + 7y + 2z = 26$

e. Use **trapezoidal rule** with ten strips to estimate. (4 Marks)

$\int_0^{10} \frac{e^2}{1+x^2}\,dx$

f. Given the differential equations:

$\frac{dy}{dx} = 2xy$, $y(0) = 0.5$, solution required for $1 \geq x \geq 0$

By taking a step size of 0.2, solve the differential equations by **Runge-Kutta's** second order method. (5 Marks)

g. Find the smallest root of the following equation by using the **Newton Raphson** method. (5 Marks)

$x^3 = 4x + 1 = 0$

QUESTION TWO – 20 MARKS

a. Solve the system of equations below by **matrix inversion** method (8 Marks)

$2y_1 + y_2 + y_3 = 10$

$3y_1 + 2y_2 + 9y_3 = 18$

$y_1 + 4y_2 + 9y_3 = 16$

b. Derive the **Regular –falsi iterative method**. (5 Marks)

c. Using **Gauss Jordan,** solve the system of equations below: (7 Marks)

$x_1 + 4x_2 – x_3 = -5$

$x_1 + x_2 – 6x_3 = -12$

$3x_1 – x_2 – x_3 = 4$

QUESTION THREE – 20 MARKS

a. Given the following data, estimate G(1.85) using **Newton-Gregory Forward Interpolation Polynomial**.

m	1	3	5	7	9
G (m)	0	1.0986	1.6094	1.9459	2.1972

(6 Marks)

b. The velocity of a car at intervals of 2 minutes is given below:

Time (Minutes)	0	2	4	6	8	10	12
Velocity (Km/hr)	0	22	30	27	18	7	0

Apply **Simpson's** 1/3 rule to find the distance covered by the car in the 12 minutes tabulated above. (6 Marks)

c. Given the equation $x^3 - 4x + 1 = 0$ and taking $x_0 = 0$ and $x_1 = 1$ perform the first ten iterations in an attempt to solve the equation using **successive bisection method**. Determine the absolute percentage error at the tenth iteration. (8 Marks)

QUESTION FOUR – 20 MARKS

a. For the following table of values:

x	1	2	3	4
F (x)	1	8	27	64

i. Find F (2.5) using **Lagrange Interpolation** with a **quadratic** interpolating polynomial. (5 Marks)
ii. Repeat (i) above using a **cubic** interpolating polynomial. (5 Marks)
iii. Compare the two values obtained by the two methods and comment on the level of accuracy, hence determine the **absolute relative approximate error** and express it as a percentage. (2 Marks)

b. Solve the equation below by using **Runge-Kutta Fourth Order Method,** using a step of size of 0.2 (8 Marks) $\frac{dy}{dx} = y - \frac{2x}{y}$; y(0) = 1

Solution required for $1 \geq x \geq 0$

QUESTION FIVE – 20 MARKS

a. Using **Newton-Gregory backward interpolation formula**, find Cosh (0.38), given: (5 Marks)

x	0.1	0.2	0.3	0.4
CoshX	1.005	1.020	1.0045	1.081

b. Using **Gauss elimination,** solve the system of equations below: (5 Marks)

$x_1 + x_2 + x_3 = 3$
$2x_1 + 3x_2 + x_3 = 6$
$x_1 - x_2 - x_3 = -3$

c. Solve the equation below by using **Euler's method,** using a step size of 0.2 (5 Marks)

$\frac{dy}{dx} = y - x^2 + 1$; y (0) = 0.5

Solution required for $1 \geq x \geq 0$

d. Using **Secant method,** find the smallest positive root of the following equation (5 Marks)

$f(x) = x^3 - 3x^2 + x + 1 = 0$