UNIVERSITY OF COLOMBO, SRI LANKA

FACULTY OF TECHNOLOGY

LEVEL III EXAMINATION IN TECHNOLOGY - SEMESTER I – 2021

IA 3011 – APPLIED NUMERICAL METHODS

Two (02) hours

Answer all questions.

Electronic calculators are allowed.

No. of pages: 05

Important Instructions to Candidates

- If a page or part of this question paper is not printed, please inform the supervisor immediately.
- Enter your index number on all pages of the answer script.
- Write the answers to the questions in the space provided in the question paper.
- Electronic devices capable of storing and retrieving text, including electronic dictionaries and mobile phones are not allowed.

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Q	M
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Total	

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01.

(a). Determine the value of $22.222 * 99.999$ when the computer that represents only 4 significant digits with rounding and chopping? *(4 marks)*

(b). Determine the number of significant digits of the 0.00065? *(4 marks)*

(c)

(i) Convert binary number 1001.0101 to decimal. *(4 marks)*

(ii) Find the binary fraction equivalent of the decimal number: 54.6875. *(4 marks)*

(d). What is the next iterative value of the root of x^2 - 4 = 0 using the Newton-Raphson method, when the initial guess is 3? *(4 marks)*

(e). The root of x^3 = 4 is found by using the Newton-Raphson method. The successive iterative values of the root are given in the table below. What is the iteration number that has highest accuracy at least two significant digits in the answer. *(5 marks)*

Iteration Number	Value of the root
0	2.0000
1	1.6667
2	2.5911
3	1.5874
4	1.5874

02.

The following data is given for the velocity of the rocket as a function of time.

t (s)	0	14	15	20	30	35
v(t)(m/s)	0	227.04	362.78	517.35	602.97	901.67

(i). Find the velocity at t = 21s, using the quadratic polynomial, $v(t) = at^2 + bt + c$ to approximate the velocity profile. *(7 marks)*

(ii). Hence find the exact value the acceleration at t=21s. *(3 marks)*

(iii). Use forward divided difference approximation to find the acceleration of the rocket at t=21s. *(6 marks)*

(iv). Use backward divided difference approximation to find the acceleration of the rocket at t=21s. *(6 marks)*

(v). Which gives most accurate approximation to the acceleration at t=21s when compared to the exact solution? *(3 marks)*

03.

An experiment consists of y vs. x data as given below.

x	1	10	20	30	40
y	1	100	400	600	1000

(i). What are the mean values of x data and y data? *(4 marks)*

(ii). Find the least square regression line for the given data points using the linear regression $y = a_0 + a_1 x$. *(7 marks)*

(iii). Use the least squares regression line as a model to estimate y when $x = 22$. *(3 marks)*

(iv). Find the y at $x = 22$ using the direct method for linear interpolation. *(7 marks)*

(v). The absolute percentage relative approximate error between linear regression and linear interpolation at $x = 22$. *(3 marks)*

04.

The velocity (m/s) of a person is given as a function of time (seconds) by $v(t) = 200\ln(1+t) - t$ where $t \geq 0$.

(i). What is the exact distance travel by the person from t = 2 to t = 12 seconds? *(3 marks)*

(ii). Calculate the approximate distance travelled in meters by the person from t = 2 to t = 12 seconds using Euler's method with a step size of 5 seconds. *(8 marks)*

(iii) Calculate the approximate distance travelled in meters by the person from t = 2 to t = 12 seconds using one-segment trapezoidal rule? *(8 marks)*

(iv) Which numerical method (either Euler's method or one-segment trapezoidal rule) gives the most approximate answer to the exact solution? *(6 marks)*

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