MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING

DEPARTMENT OF MINING & MINERAL PROCESSING ENGINEERING
DEPARTMENT OF CHEMICAL & PROCESSING ENGINEERING
DEPARTMENT OF METALLURGICAL ENGINEERING

MODULE: ENGINEERING MATHEMATICS III

CODE: HGEN214

SESSIONAL EXAMINATIONS
OCTOBER 2021

DURATION: 3 HOURS

EXAMINER: MR A. ZVAWANDA

INSTRUCTIONS

1. *Answer **All** in Section A*
2. *Answer **three** questions in Section B.*
3. *Start a new question on a fresh page*
4. *Total marks 100*

Additional material(s): *Non-programmable electronic scientific calculator, List of formulae.*

SECTION A: *(ANSWER ALL QUESTIONS)* [40 Marks]

A1. Convert the following

(a). 101.0101_2 to denary,

(b). 0.1011_2 to denary,

(c). 0.59375_{10} to binary,

(d). 58.3125_{10} to binary, and

(e). 5613.90625_{10} to binary.

[2, 2, 2, 2, 2]

A2.

(a). State and explain any two sources of errors in numerical computing

(b). Solve the following system of equations using LU decomposition

$$\begin{aligned} x + 2y + 3z &= 12 \\ 2x + 3y + z &= 8 \\ 3x + y + 2z &= 10 \end{aligned}$$

[5, 10]

A3.

If $w = 0.3721448693$ and $z = 0.3720214371$, what is the relative error in the computation of $w - z$ in a minicomputer that has five decimal digits of accuracy? **[5]**

A4.

Solve the following system of equations using Jacobi Iterative method

$$\begin{aligned} 5a + b + c &= 10 \\ a + 6b - 2c &= 7 \\ a - 3b + 7c &= 16 \end{aligned}$$

[10]

SECTION B: *(ANSWER ANY THREE (3) QUESTIONS)* [60 Marks]

B5.

(a). Convert the following hexadecimal numbers into their binary equivalents

(i). 37_{16},

(ii). ED_{16},

(iii). $9F_{16}$ and

(iv). $A21_{16}$.

(b). Convert BD_{16} into a denary number

(c). Use the Simpson Rule with 5 data points to approximate π from the formula

$$\frac{\pi}{4} = \int_0^1 \frac{dx}{1+x^2}.$$

[2, 2, 2, 2, 3, 9]

B6.

(a). Use the trapezoidal rule with $n = 6$ to approximate the value of

$$\int_2^7 \frac{dx}{x}.$$

How does this compare with the exact answer?

(b). Determine the parameters a_0 , b_0 , d_0 and a_1 , b_1 , c_1 , d_1 so that

$$S(x) = \begin{cases} d_0x^3 - 3x^2 + b_0x + a_0, & -1 \le x \le 0 \\ d_1\mathrm{x}^3 - \mathrm{c}_1\mathrm{x}^2\mathrm{z} + \mathrm{b}_1\mathrm{x} + \mathrm{a}_1, & 0 \le x \le 1 \end{cases}$$

Is the natural cubic spline function such that $S(-1) = 1$, $S(0) = 2$ and $S(1) = -1$

[10, 10]

B7.

(a). Derive the Newton – Raphson method for solving an equation $f(x) = 0$

(b). Use the Newton – Raphson Method to find the root of the equation $x^2 - 3\sin x + 2\ \mathrm{In}\,(x+1) - 3.5$ correct to 3 significant figures

(c). Use the equation $x^k = a$ to derive the Newton-Raphson iteration formula

$$x_{n+1} = x_n - \frac{x_{n-a}^k}{kx_n^{k-1}},$$

for finding the k^{th} root of a

[5, 8, 7]

B8.

(a). Let

$$f(y) = \frac{y\cos y - y}{y - \sin y}.$$

Use four – digit rounding arithmetic to evaluate $f(0{,}1)$.

(b). Carry out the first three iterations of the Gauss-Siedel iteration process to find the solution for the following set of equations

$$\begin{aligned} 8a_1 + 2a_2 + 3a_3 &= 30 \\ a_1 - 9a_2 + 2a_3 &= 1 \\ 2a_1 + 3a_2 + 6a_3 &= 31 \end{aligned}$$

given the initial guess $a_0 = (1\ \ 1\ \ 1)$

[5, 15]

END OF QUESTION PAPER