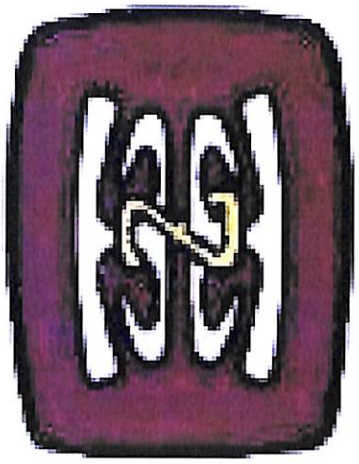
PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINERING

EXAMINATION QUESTION PAPERS



ME 212
NUMERICAL METHODSS

SEMESTER ONE – 2024

BY GK

PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY (PNGUOT)
MECHANICAL ENGINEERING

ME212: Numerical Methods
First Semester Examination, 2024
Second Year Mechanical Engineering
Tuesday, May 28th, 2024- 8:20 A.M
Location: M118

Time Allowed: 2 Hrs

Instructions:

1. *You have 10 minutes to read the paper. Do not write anything during this time.*
2. *Write your **name** clearly on the front page using **Capital letters**.*
3. *There are **total five (5) questions. Answer any four (4) questions.***
4. *All questions carry equal marks.*
5. *All questions must be answered only in the booklet provided.*
6. *Calculators are permitted in the examination room.*
7. *Any student found cheating will be disqualified.*

Question 1: (25 Marks)

PART-A (5 Marks)

A. Define types of errors that occur in numerical methods?

PART-B (20 Marks)

B. Given the following equation:

$$x^4 - x - 10 = 0$$

(a) Use Newton-Raphson method to find the root correct to three decimal places with initial guess as $x_0 = 2$.
(b) Determine the approximate relative error after each iteration.

Question 2: (25 Marks)

PART-A (5 Marks)

A. What type of solution you expect when you are using the Numerical methods?

PART-B (20 Marks)

B. Solve the system of linear equations using Gauss-elimination method with pivoting.

$$2x_1 + x_2 + x_3 = 5$$
$$4x_1 - 6x_2 = -2$$
$$-2x_1 + 7x_2 + 2x_3 = 9$$

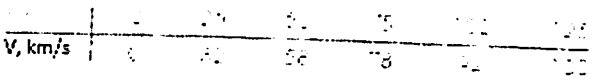
Question 3: (25 Marks)

A. Use the given data to:

(a) Use Least-squares regression to fit a straight line. Find y at x=4.5.
(b) Interpolate f (4.5) using Lagrange Polynomials of order 2.
(c) Compare (a) and (b)

Question 4: (25 Marks)

A. The following data was collected for the velocity versus time for a rocket:



(a) Use numerical differentiation to estimate the rocket's acceleration at t=25 sec, t=100 sec respectively.
(b) Use Single application Simpsons 1/3 rule, numerical integration to find the Distance travelled by rocket from t=0 sec to t=50 sec.

Question 5: (25 Marks)

A. Compute y (1.4), where y (1) =0.

$$\frac{dy}{dt} = 1 + \frac{y}{t} + \left(\frac{y}{t}\right)^2 \quad 1 \le t \le 3$$

(a) Euler's method with h=0.2
(b) Fourth order RK method with h=0.2.

Helpful Hints:

1. $P_n(x) = \sum_{i=0}^{n} f_i l_i(x)$ ... (v)

   $l_i(x) = \prod_{j=0, j\neq i}^{n} \left(\frac{x-x_j}{x_i-x_j}\right)$ ... (vi)

2. $y_{i+1} = y_i + f(x_i, y_i).h$

3. $m_1 = f(x_i, y_i)$

   $m_2 = f\left(x_i + \frac{h}{2}, y_i + \frac{m_1 h}{2}\right)$

   $m_3 = f\left(x_i + \frac{h}{2}, y_i + \frac{m_2 h}{2}\right)$

   $m_4 = f(x_i + h, y_i + m_3 h)$

   Then, the general form of extrapolation equation (i) will be:

   $y_{i+1} = y_i + \frac{h}{6}(m_1 + 2m_2 + 2m_3 + m_4)$ ... (ii)

4. $I = \frac{h}{3}(f_0 + 4f_1 + f_2)$

5. $y = a + bx$

   $b = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{n\sum x_i^2 - (\sum x_i)^2}$ .... (iv) & $a = \frac{\sum y_i}{n} - b\frac{\sum x_i}{n}$

Good luck!!!