



# University of Ruhuna- Faculty of Technology

## Bachelor of Biosystems Technology Honours Degree

### Level 1 (Semester I) Examination, June/July 2025

#### Academic year 2023/2024

**Course Unit: TMS 1173 Fundamentals of Mathematics (Written)      Duration: 03 hours**



- This paper contains six questions
- Answer all questions
- All symbols have their usual meanings
- Calculators are not allowed

**Q1:**

In an online course comprising 150 students, participants were surveyed regarding the devices they used to perform their learning activities. The results were:

- 18 students used only laptops.
- 22 students used both desktops and smartphones.
- 10 students used all three devices: laptops, desktops, and smartphones.
- 30 students used both laptops and desktops.
- 25 students used both laptops and smartphones.
- 40 students used smartphones.
- 7 students did not use laptops, desktops, or smartphones.

a) Draw a Venn diagram to represent the number of students using each type of device as following: (40 marks)

- L: Laptops
- D: Desktops
- S: Smartphones

b) How many students used desktops? (15 marks)

c) How many students used at least one of the three devices? (15 marks)

d) Shade the two specified regions of the Venn diagram below using **two different patterns** (e.g., stripes, dots), and **clearly label** each shaded region with its corresponding name.

- i. area of  $L \cup D$  (15 marks)
- ii. area of  $L \cap D \cap S$  (15 marks)

**Q2:**

a) Let A is a  $2 \times 2$  matrix and B is a  $2 \times 1$  matrix such that,

$$A = \begin{pmatrix} 3 & 2 \\ 1 & -2 \end{pmatrix}_{2 \times 2} \quad B = \begin{pmatrix} 13 \\ -1 \end{pmatrix}_{2 \times 1}$$

- i. Determine the product of A and B. (10 marks)
- ii. Calculate the determinant of A. (10 marks)
- iii. Find the inverse of A. (20 marks)
- iv. Solve the following linear simultaneous equations by using the above results.

$$3x + 2y = 13$$

$$x - 2y = -1 \quad (30 \text{ marks})$$

b) Solve the following linear simultaneous equations using the **substitution or elimination method**.

$$5a - 3b = 11$$

$$3a - b = 9 \quad (30 \text{ marks})$$

**Q3:**

a) Simplify the following expressions, giving the answers in index form and with positive indices.

i.  $81^{0.25}$  (15 marks)

ii.  $\frac{x^2y^3 + xy^2}{xy}$  (15 marks)

b) Multiply expression,  $(3x - 2y^2 + 4y)$  by expression,  $(2x - y)$ . (15 marks)

c) If  $x = 5$  and  $y = 6$ , evaluate the expression, (15 marks)

$$\frac{23(x-y)}{y+xy+2x}$$

d) When  $a$  and  $b$  are constants, factorize the expression, (20 marks)

$$2ax - 3ay + 2bx - 3by$$

e) Factorize and simplify the following expression, (20 marks)

$$\frac{3x^2+6x-3xy}{2y+xy-y^2}$$

Q4:

a) Consider the following two functions  $y_1$  and  $y_2$ ,

$$y_1 = -3x$$

$$y_2 = 2x + 3$$

i. Plot above two functions,  $y_1$  and  $y_2$  on a same Cartesian plain. (20 marks)

ii. Identify the **gradient (slope)** of each function. (10 marks)

iii. Determine the **y-intercept** of the  $y_2$  function. (10 marks)

b) Consider the following quadratic function,

$$f(x) = 2x^2 - 4x - 6$$

i. Determine the coordinates of the **y-intercept** and **x-intercepts** of the function. (30 marks)

ii. Find the **Vertex** and equation of the **Axis of symmetry** of the function. (30 marks)

Q5:

a) Write the following two numbers in Scientific notation

i. 5,200,000 (10 marks)

ii. 0.000048 (10 marks)

b) Evaluate the following logarithmic expressions

i.  $\log_9(3)$  (15 marks)

ii.  $\log_{10} 0.001$  (15 marks)

c) Evaluate the following logarithmic expression (25 marks)

$$\frac{\log 25 - \log 125 + \frac{1}{2} \log 625}{3 \log 5}$$

d) Solve the following logarithmic equation (25 marks)

$$\log_a(x - 1) + \log_a(x + 8) = 2 \log_a(x + 2)$$

Q6:

a) Evaluate the following limits

i.  $\lim_{x \rightarrow 0} \frac{(x+4)^2 - 16}{x}$  (15 marks)

ii.  $\lim_{x \rightarrow 3} \frac{x^2 - 7x + 12}{x - 3}$  (15 marks)

b) Differentiate the following functions with respect to x,

i.  $y = 2x^4 + x$  (15 marks)

ii.  $y = (x + 3)^2(2x - 1)$  (25 marks)

c) Evaluate the following indefinite integral

$$\int (5x^2 - 8x + 5) dx$$
 (15 marks)

d) Evaluate the following definite integral

$$\int_1^3 (3x^2 - 8x + 5) dx$$
 (15 marks)

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