الجامعة الوطنية
National University
Science & Technology للعلوم والتكنولوجيا
كلية عمان البحرية الدولية
International Maritime College Oman

Final Exam
TMATH-I: TECHNICAL MATH 1
Fall 2024

Points of attention:

- For each question, the maximum earned points are specified in the question.
- Write clearly! Answers that are not readable are not marked and don't earn marks!
- All answers should be written in English using **blue or black pens** only.
- Use the pencil only for diagrams and graphs.
- Show all the calculation steps in the given space.
- When finished, submit the question paper, together with the answer scripts and the signed cover page to the invigilator.
- Any cheating/copying may result in an instant failing of the examination.

Exam Duration: 2.5 hours
Instructor's Name: Dr. Rokhsaneh Yousef Zehi
Exam Date: 05/01/2025
Program: PE

	40
	10

Student Information

Name: ID:

Signature:

Invigilator

Initials: ☐ Student ID checked

Time received:

Question 1 **[8 marks]**

Answer the following question:

a. Evaluate the following integral: (4 marks)

$$\int \frac{4x-1}{x^2+x-2}\,dx$$

b. Given that $\boldsymbol{y\cos x + x\sin y = xy}$. Find $\boldsymbol{\frac{dy}{dx}}$. (4 marks)

Question 2 **[4 marks]**

Water is dripping out of a cylindrical tank at a rate of 0.3 m^3/s. Determine the rate of change of the water level (h) per minute, considering the radius of tank to be $6\ m$.

Question 3 **[5 marks]**

The heat transfer rate in a heating system at a distance x from the heat source is given by

$$f(x) = \sqrt{25 - x^2}\,.$$

The total heat transferred through the system from $x = 0$ to $x = 5$ can be calculated by

$$Q = \int_0^5 f(x)\,dx$$

Approximate the total heat transferred using **trapezium rule** with $n = 5$. Write your answer correct to 3 decimal places.

Question 4 **[5 marks]**

The Temperature T (in ℃) of a rotating machine part that has been in operation for t hours is given by:

$$T = \frac{150(t+2)}{(t+3)^2}$$

Determine the rate of change of Temperature when $t = 6$ hours.

Question 5 **[5 marks]**

Determine the volume of solid formed by revolving the curve $\boldsymbol{y = \cos x}$ about the x-axis from $x = 0$ to $x = \frac{\pi}{2}$.

Question 6 **[5 marks]**

An object is travelling along a straight line and its velocity at time t (in hours) is given by $\boldsymbol{v(t) = te^{-t}}$ meters per hour. The distance $d(t)$ traveled by the object at any time t is related to the velocity by:

$$d(t) = \int v\, dt$$

a. Determine the distance the object has travelled from $t = 1$ hour to $t = 4$ hours. (4 marks)

b. Determine the average velocity of the object over this time interval. (1 mark)

Question 7 **[8 marks]**

The rate of decrease of temperature (T ℃) of an object with time (t minutes) satisfies the differential equation $\frac{dT}{dt} = -k(T - 21)$, where k is a positive constant.

a. Determine the general solution for T. (4 marks)

b. Given that the initial temperature of the object is 90℃ and it cools to 80℃ in 5 minutes, find a particular solution for T. (3 marks)

c. Use the solution found in part b, to determine the temperature of the object after 15 minutes. (1 mark)

Formula sheet

Volume of Cylinder with radius r is given by: $\boldsymbol{\pi r^2 h}$

Trapezium rule: $\int_a^b \boldsymbol{f(x)dx} \approx \frac{\boldsymbol{h}}{\boldsymbol{2}}[\boldsymbol{y_0 + 2y_1 + 2y_2 + \cdots + 2y_{n-1} + y_n}]$

This page is for rough work.

MLO and Bloom's Level of Complexity

Q #	MLO Addressed	Complexity Level	Mark	Remark
1	**1**	Application	**8**	
2	**1, 2**	Analysis	**4**	
3	**1**	Undertesting, Application	**5**	
4	**2,3**	Application	**5**	
5	**1,4**	Application	**5**	
6	**4**	Application, Analysis	**5**	
7	**3,6,5**	Analysis	**8**	

References:

1. Anthony Croft, R. D., 2015. Mathematics for Engineers. Fourth ed. Harlow: Pearson.
2. J. Washington, A., 2014. Basic Technical Mathematics with Calculus. 10 ed. Harlow: Pearson Education Limited.
3. CGP Books (2017) Mathematics for A-level. Cumbria: Coordination Group Publications.