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

Final Exam
TMATH-II: TECHNICAL MATH II
Spring 2025

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: 18/06/2025
Program: PE

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Student Information

Name: ID:

Signature:

Invigilator

Initials: ☐ Student ID checked

Time received:

Question 1 **[7 marks]**

A tank contains water contaminated with a chemical. A filter system removes the chemical continuously. The rate at which the concentration M (in mg/L) of the chemical decreases is modeled by the following differential equation:

$$\frac{dM}{dt} = -k(M - 5)$$

where k is a positive constant.

a. Find the general solution for $M(t)$. (3 marks)

b. If the initial concentration is $\mathbf{60\ mg/L}$ and decreases to $\mathbf{30\ mg/L}$ in $\mathbf{20}$ minutes, determine k and find a particular solution for $M(t)$. (3 marks)

c. Find the concentration after **60** minutes. (1 mark)

Question 2 **[8 marks]**

A mechanical system consists of a mass attached to a spring and a damping element. The displacement $x(t)$ of the mass from its equilibrium position is modeled by the following second-order differential equation:

$$\frac{d^2x}{dt^2} - 6\frac{dx}{dt} + 8x = 2\mathrm{t} + 5e^{3t} - 1$$

Obtain the particular solution to this differential equation that satisfies the initial conditions $x(0) = 2\,, x'(0) = 3.$

Question 3 **[6 marks]**

Determine the position and nature of the stationary point of the following function

$$f(x,y) = x^2 + y^3 - 2x - 3y + 3xy$$

Question 4 **[6 marks]**

The temperature $T(x, y)$ of a fluid flowing through an insulated pipe is modeled by the function:

$$T = \frac{(2x - 3y)^2}{x^2 + e^{xy}}$$

Where x is the distance along the length of the pipe (in meters), and y is the radial distance from the center of the pipe (in meters).

a. Find the partial derivatives $\partial T/\partial x$ and $\partial T/\partial y$. (5 marks)

b. Evaluate both partial derivatives at the point $(x, y) = (1,2)$. (1 mark)

Question 5 **[7 marks]**

The currents i_1, i_2 and i_3 of a circuit are related by

$$2i_1 + i_2 - i_3 = 8$$

$$i_1 - i_2 + i_3 = -5$$

$$3i_1 + 2i_2 = 9$$

Use Carmer's rule to evaluate the three currents.

Question 6 **[6 marks]**

Determine the inverse of the following matrix.

$$A = \begin{pmatrix} -3 & -1 & 2 \\ 4 & 7 & 1 \\ 2 & 0 & 1 \end{pmatrix}$$

MLO and Bloom's Level of Complexity

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

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. Stewart, J., 2008. *Calculus: Early Transcendentals*. 6th ed. Boston: Brooks/Cole.