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

Final Exam
TMATH-II: TECHNICAL MATH 2
Spring 2026

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: 13/05/2026
Program: PE

	40
	10

Student Information

Name: ID:

Signature:

Invigilator

Initials: ☐ Student ID checked

Time received:

Question 1 **[6 marks]**

A continuously stirred tank reactor of volume $100\ L$ is fed with a solution at a flow rate of $5\ L/min$. Let $y(t)$ be the concentration of the reactant in the tank at time $t$minutes. The system is modeled by:

$$\mathbf{100}\frac{\boldsymbol{dy}}{\boldsymbol{dt}} + \mathbf{5}\boldsymbol{y} = \mathbf{20}\boldsymbol{e}^{-\mathbf{0.2}\boldsymbol{t}}$$

where $y(t)$ is measured in mol/m^3, and t is measured in minutes.

a. Determine the general solution for $y(t)$. (5 marks)

b. If $y(0) = 2$, determine a particular solution for $y(t)$. (0.5 marks)

c. Determine the concentration of the reactant after 20 minutes. (0.5 marks)

Question 2 **[8 marks]**

A mass–spring system is subjected to an external periodic force $F(t) = 5\sin(2t)$. The displacement $x(t)$ satisfies the following differential equations:

$$\frac{d^2x}{dt^2} + 3\frac{dx}{dt} + 2x = 5\sin(2t)$$

with initial conditions

$$x(0) = 0, \quad x'(0) = 1.$$

Obtain a particular solution for the displacement $x(t)$.

Question 3 **[7 marks]**

Given the following function

$$\boldsymbol{f(x,y) = x^2 - 4x + y^2 e^y}$$

Determine the position and nature of the stationary points of $f(x,y)$.

Question 4 **[7 marks]**

For the following functions find the first order partial derivatives.

a. $z = \frac{x + cosy}{x^2y + 1}$ (3 marks)

b. $z = \ln \frac{y^2}{x-y} + e^{-x} \sin xy$ (4 marks)

Question 5 **[6 marks]**

In an electrical circuit with three branches, the currents I_1, I_2 and I_3(in amperes) are related by the following equations:

$$\mathbf{5}\boldsymbol{I_1} + \mathbf{2}\boldsymbol{I_2} - \boldsymbol{I_3} = \mathbf{12}$$

$$\mathbf{3}\boldsymbol{I_1} + \mathbf{4}\boldsymbol{I_2} + \mathbf{2}\boldsymbol{I_3} = \mathbf{20}$$

$$\mathbf{2}\boldsymbol{I_1} - \boldsymbol{I_2} + \mathbf{3}\boldsymbol{I_3} = \mathbf{7}$$

Using Cramer's Rule, determine the values of the currents I_1, I_2 and I_3.

Question 6 **[6 marks]**

Determine the inverse of the following matrix.

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

This page is for rough work.

Formula sheet:

Inhomogeneous term	Trial solution
Constant	Constant
$ax^r + \cdots + bx + c$	$\alpha x^r + \cdots + \beta x + \delta$
$a\cos kx$	$\alpha\cos kx + \beta\sin kx$
$a\sin kx$	$\alpha\cos kx + \beta\sin kx$
ae^{kx}	αe^{kx}

MLO and Bloom's Level of Complexity

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

References:

Anthony Croft, R. D., 2015. Mathematics for Engineers. Fourth ed. Harlow: Pearson.

J. Washington, A., 2014. Basic Technical Mathematics with Calculus. 10 ed. Harlow: Pearson Education Limited.

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