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

ACADEMIC YEAR 2023 - 2024

Program	Year	Semester	Paper
PE	1	2	MAIN

MODULE NAME:	**TECHNICAL MATH**		
MODULE CODE:	**PT-TMATH**	**EXAM DATE:**	**10.06.2024**
INSTRUCTOR's NAME:	**Dr. Yaqoob Mubarak Al Rahbi**	**DURATION:**	**2 hrs.**

Questions to be answered on:	**Allowed tools:**	**Number of pages**
✓ Space provided on the question paper	Pen, Pencil & Calculator	(Incl. cover page)**:** **11**

Points of attention:

- For each question, the maximum earned points are mentioned between brackets at the end of each question.
- Write very clearly! Answers that are not readable are not marked and don't get points!
- Make sure your answers are written to the point.
- All answers should be written **in English.**
- Write all the answers in **blue or black pen only.**
- Use the **pencil** only for **diagrams & 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.

FINAL MARKS

	40
	10

STUDENT NAME:

STUDENT ID:

Number of answer scripts:……..…….

Invigilator:……..……..…..

Student's signature: ……

Time of receipt:……..…..

ANSWER ALL THE QUESTIONS

1. Calculate the first derivative of the following functions: **[6 Marks]**

a) $y = \cos 2x - \sin 4x$.

b) $y = \sqrt{x^2 + 1}$

c) $y = \frac{1-x}{1+x}$

2. Find the integral using an appropriate technique. **[6 Marks]**

a) $\int x \sin 2x \, dx$

b) $\int \frac{dx}{\sqrt{100-x^2}}$

c) $\int_0^{\pi} \cos t \, dt$

3. Calculate the equation of the tangent to $y = 3x^2 - x + 9$ where $x = 2$. **[4 Marks]**

4. Find the volume of the solid generated when the curve $y = 3x^2$ for $0 \leq x \leq 1$ is rotated around the $y-$axis. **[4 Marks]**

5. Solve the equation **[4 Marks]**

$$\frac{dy}{dx} = 3x^2e^{-y}$$

subject to the condition $y(1) = 0$.

6. Find the the solution of the equation **[4 Marks]**

$$x\frac{dy}{dx} - y = x$$

subject to the condition $y(1) = 2$.

7. If $y(x) = x^2$, then **[4 Marks]**

a) Use the definition to calculate the rate of change of y.

b) Calculate the rate of change of y when $x = 6$.

8. Locate all maximum points and minimum points of **[4 Marks]**

$$y = \frac{x^3}{3} - \frac{x^2}{2} + 1$$

9. Verify that **[4 Marks]**

$$y = Asin\ kx + Bcos\ kx$$

, where A, B, k constants is a solution of

$$y'' + k^2 y = 0.$$

Draft Page

Formulas sheet:

No	Function	Derivative	Indefinite integral
1)	k	0	$kx + c$
2)	x^n	nx^{n-1}	$\frac{x^{n+1}}{n+1} + c$
3)	$\frac{1}{x} = x^{-1}$	$\ln x$	----------
4)	e^{kx}	ke^{kx}	$\frac{e^{kx}}{k} + c$
5)	$\ln kx$	$\frac{1}{x}$	----------
6)	$\sin(kx + a)$	$k\ \cos(kx + a)$	$\frac{-\cos(kx + a)}{k} + c$
7)	$\cos(kx + a)$	$-k\ \sin(kx + a)$	$\frac{\sin(kx + a)}{k} + c$
8)	$\tan(kx + a)$	$k\ \sec^2(kx + a)$	$\frac{1}{k}\ln\lvert\sec(kx + a)\rvert$
9)	$\sin^{-1}(kx)$	$\frac{k}{\sqrt{1-(kx)^2}}$	----------
10)	$\cos^{-1}(kx)$	$\frac{-k}{\sqrt{1-(kx)^2}}$	----------
11)	$\tan^{-1}(kx)$	$\frac{k}{1+(kx)^2}$	----------
12)	$\frac{1}{x^2 + a^2}$	----------	$\frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right) + c$
13)	$\frac{1}{x^2 - a^2}$	----------	$\frac{1}{2a}\ln\left(\frac{x-a}{x+a}\right) + c$
14)	$\frac{1}{a^2 - x^2}$	----------	$\frac{1}{2a}\ln\left(\frac{a+x}{a-x}\right) + c$
15)	$\frac{1}{\sqrt{x^2 + k}}$	----------	$\ln\left(x + \sqrt{x^2 + k}\right) + c$
16)	$\frac{1}{\sqrt{a^2 - x^2}}$	----------	$\sin^{-1}\left(\frac{x}{a}\right) + c$
17)	$\frac{d}{dx}(cu) = c\frac{du}{dx}$		
18)	$\frac{d}{dx}(u + v) = \frac{du}{dx} + \frac{dv}{dx}$		
19)	$\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}$		
20)	$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$		
21)	$\frac{dy}{dx} = \frac{dy}{du}\frac{du}{dx}$		
22)	$\frac{d}{dx}(u^n) = nu^{n-1}\left(\frac{du}{dx}\right)$		
23)	$y - y_1 = m(x - x_1)$		
24)	$y - y_1 = \frac{-1}{m}(x - x_1)$		