UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF MARINE ENGINEERING TECHNOLOGY

FINAL EXAMINATION
JANUARY 2016 SEMESTER

COURSE CODE	:	LMD10803
COURSE NAME	:	TECHNICAL MATHEMATICS 2
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	DIPLOMA OF ENGINEERING TECHNOLOGY IN MARINE ENGINEERING
DATE	:	19 MAY 2016
TIME	:	09.00 AM – 11.30 AM
DURATION	:	2 HOURS 30 MINUTES

INSTRUCTIONS TO CANDIDATES

1. Please CAREFULLY read the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of TWO (2) sections; Section A and Section B.
4. Answer ALL questions in Section A. For Section B, answer TWO (2) questions only.
5. Please write your answers on the answer booklet provided.
6. Answer all questions in English language ONLY.

THERE ARE 7 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 15 marks)

MULTIPLE CHOICE QUESTIONS

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

1. Determine the period of $y = 8\sin 2x$.

   A. 8π
   B. $\frac{\pi}{8}$
   C. π
   D. 4π

2. Simplify the trigonometric expression: $\sec\theta\cos\theta$.

   A. $\sec\theta$
   B. $\cos\theta$
   C. $\tan\theta$
   D. 1

3. Given $\cos\theta = \frac{6}{10}$, find the value of $\sin\theta$ if $270^0 \le \theta \le 360^0$

   A. $\frac{6}{8}$
   B. $-\frac{6}{8}$
   C. $-\frac{8}{10}$
   D. $-\frac{8}{10}$

4. The range of $f(x) = x^3 + 12$ is:

   A. $-\infty < f(x) < \infty$
   B. $0 < f(x) < \infty$
   C. $-12 < f(x) < \infty$
   D. $-\infty < f(x) < 12$

5. Given $m(x)=4x-2$, compute $m\left(\frac{1}{2}\right)$.

A. 0
B. 2
C. -2
D. 4

6. Determine $\lim_{s\to 7}\frac{s^2-49}{(s-7)}$

A. 7
B. 0
C. 14
D. -7

7. Differentiate y with respect to x for $(3x-4)^{-2}$.

A. $-2(3x-4)^{-3}$
B. $-6(3x-4)^{-3}$
C. $2(3x-4)^{-3}$
D. $6(3x-4)^{-1}$

8. Given that $k(t)=3t^{-\frac{1}{3}}$. Determine $k'(t)$.

A. $t^{-\frac{4}{3}}$
B. $t^{\frac{4}{3}}$
C. $-t^{\frac{4}{3}}$
D. $-t^{-\frac{4}{3}}$

9. The derivative of $y=e^{2x^2-2}$ is :

A. $4e^{2x^2-2}$
B. $-e^{2x^2-2}$
C. xe^{2x^2-2}
D. $4xe^{2x^2-2}$

10. The differentiation of $\tan 5x$ with respect to x is :

A. $5\sec^2(5x)$

B. $\sec^2(5x)$

C. $-\sec^2(5x)$

D. $-5\sec^2(5x)$

11. Choose the correct formula for *power rule.*

A. $\frac{d}{dx}(x)^n = n(x)^n$

B. $\frac{d}{dx}(x)^n = n(x)^{n-1}$

C. $\frac{d}{dx}(x)^n = -n(x)^n$

D. $\frac{d}{dx}(x)^n = \frac{n(x)^{n+1}}{n+1}$

12. The integration of $y=\frac{1}{3x+2}$ is :

A. $\frac{\ln|3x+2|}{2}+C$

B. $\ln|3x+2|+C$

C. $\frac{\ln|3x+2|}{3}+C$

D. $3\ln|3x+2|+C$

13. If $\int_a^b f(x)\,dx = p$ and $\int_b^c f(x)\,dx = -q$, evaluate $\int_a^c -2f(x)\,dx$.

A. $-2p+2q$

B. $2p-2q$

C. $2p+2q$

D. $-2p-2q$

14. $\int\left(\frac{1}{x^{-7}}-3\right)dx$

A. $\frac{x^7}{7}-3x+c$

B. $x^{-6}-3x+c$

C. $\frac{x^6}{6}-3x+c$

D. $\frac{x^8}{8}-3x+c$

15. Solve $\int-\left(\csc^2(5s)\right)\,ds$.

A. $\cot(5s)+C$

B. $-5\cot(5s)+C$

C. $5\cot(5s)+C$

D. $-\cot(5s)+C$

SECTION B (Total: 45 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

a) Given $\cos\theta = \dfrac{4}{5}$ and $270^0 \le \theta \le 360^0$, evaluate:

i. $\sin\theta$.

ii. $\sin 2\theta$.

(4 marks)

b) Simplify $\sqrt{\cos\theta(\sec\theta - \cos\theta)}$.

(4 marks)

Question 2

Given that $f(x) = \sqrt{\dfrac{x+2}{25}}$. Determine:

a) $f(14)$.

b) The value of x when $f(x) = x$.

(8 marks)

Question 3

Calculate :

a) $\lim\limits_{x \to \infty} \dfrac{x^5 + 7x^2}{4x^3 + 5x}$.

(3 marks)

b) $\lim\limits_{x \to 4} \dfrac{4(x^2 - 16)}{x - 4}$.

(3 marks)

Question 4

Differentiate:

a) $y = e^{3x}\left(\tan 7x^4\right)$.

(4 marks)

b) $y = \dfrac{x^{-2}}{\ln 5x}$.

(5 marks)

Question 5

Find $\dfrac{dy}{dx}$ using implicit differentiation for $-2x^2 + 8xy^5 - y^{-2} + 2x + 17 = 80$.

(5 marks)

Question 6

Evaluate $\displaystyle\int_3^0 \frac{6f(x)+5}{2}\,dx$ if $\displaystyle\int_0^3 f(x)dx = 5$.

(4 marks)

Question 7

By using a suitable substitution, determine $\int 4x(x^2 - 5)^{\frac{1}{2}}\,dx$.

(5 marks)

SECTION C (Total: 40 marks)

INSTRUCTION: Answer TWO questions.

Please use the answer booklet provided.

Question 1

a) Given $y = 2\cos(2x + 90^0)$.

i. State the period, amplitude and phase shift of y.

(4 marks)

ii. Sketch the graph for two cycles beginning with $x = 0$.

(6 marks)

b) Given $f(x) = 3x - 2$ and $g(x) = mx - 6$ where *m* is a constant. Determine:

i. $(f \circ g)(x)$. (in terms of m)

(3 marks)

ii. $(g \circ f)(x)$.

(3 marks)

iii. *m* if $(f \circ g)(x) = (g \circ f)(x)$.

(4 marks)

Question 2

a) Given $v = (5\cos x - x^5)^4$.

i. Show that $\frac{dv}{dx} = 4(5\cos x - x^5)^3(-5\sin x - 5x^4)$.

(4 marks)

ii. Evaluate $\frac{d^2y}{dx^2}$ in the simplest form.

(6 marks)

b) The radius of a spherical balloon increases at a rate of 0.4 cm/sec. If its radius is r =5cm, determine the increase rate of:

i. The volume of the balloon.

(5 marks)

ii. The surface area of the balloon.

(5 marks)

Question 3

a) Given $f(x)=\dfrac{5x-4}{2x^2+x-1}$.

i. Express $f(x)$ in partial fractions.

ii. Determine $\int \dfrac{5x-4}{2x^2+x-1}dx$.

(11 marks)

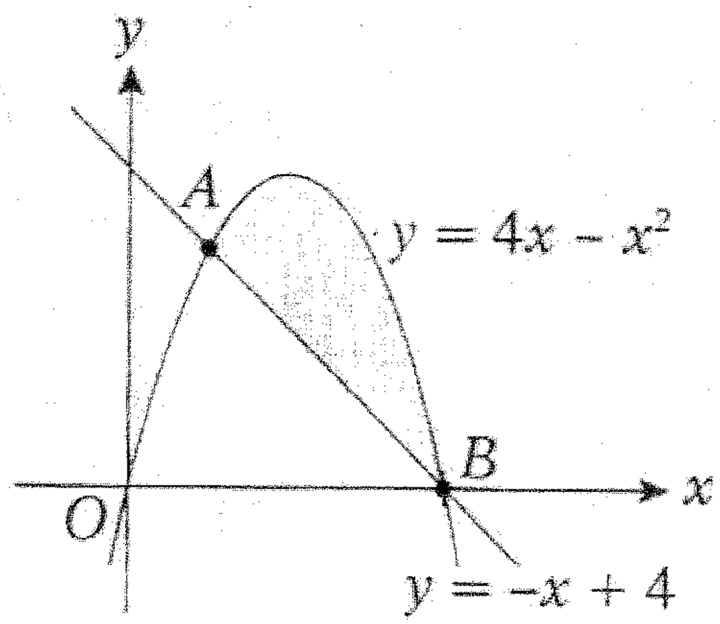

Figure 1

b) Figure 1 shows a curve $y=4x-x^2$ and a straight line $y=-x+4$ intersecting at point A and B. Evaluate the area of the region between the parabola $y=4x-x^2$ and the line $y=-x+4$.

(9 marks)

END OF QUESTION

FORMULA SHEET

TRIGONOMETRY IDENTITIES

FUNDAMENTAL IDENTITIES	FORMULAS FOR NEGATIVES
$\csc\theta = \dfrac{1}{\sin\theta}$	$\sin(-\theta) = -\sin\theta$
$\sec\theta = \dfrac{1}{\cos\theta}$	$\cos(-\theta) = \cos\theta$
$\cot\theta = \dfrac{1}{\tan\theta} = \dfrac{\cos\theta}{\sin\theta}$	$\tan(-\theta) = -\tan\theta$
$\tan\theta = \dfrac{\sin\theta}{\cos\theta}$	$\csc(-\theta) = -\csc\theta$
$\sin^2\theta + \cos^2\theta = 1$	$\sec(-\theta) = \sec\theta$
$1 + \tan^2\theta = \sec^2\theta$	$\cot(-\theta) = -\cot\theta$
$1 + \cot^2\theta = \csc^2\theta$	

ADDITION FORMULAS	SUBTRACTION FORMULAS
$\sin(A+B) = \sin A\cos B + \cos A\sin B$	$\sin(A-B) = \sin A\cos B - \cos A\sin B$
$\cos(A+B) = \cos A\cos B - \sin A\sin B$	$\cos(A-B) = \cos A\cos B + \sin A\sin B$
$\tan(A+B) = \dfrac{\tan A + \tan B}{1 - \tan A\tan B}$	$\tan(A-B) = \dfrac{\tan A - \tan B}{1 + \tan A\tan B}$

DOUBLE-ANGLE FORMULAS
$\sin 2\theta = 2\sin\theta\cos\theta$
$\cos 2\theta = \cos^2\theta - \sin^2\theta$ .... $= 1 - 2\sin^2\theta$ .... $= 2\cos^2\theta - 1$
$\tan 2\theta = \dfrac{2\tan\theta}{1 - \tan^2\theta}$

DIFFERENTIATION

STANDARD FORM	GENERAL FORM
$\frac{d}{dx}(\sin x) = \cos x$	$\frac{d}{dx}(\sin f(x)) = f'(x)\cos f(x)$
$\frac{d}{dx}(\cos x) = -\sin x$	$\frac{d}{dx}(\cos f(x)) = -f'(x)\sin f(x)$
$\frac{d}{dx}(\tan x) = \sec^2 x$	$\frac{d}{dx}(\tan f(x)) = f'(x)\sec^2 f(x)$
$\frac{d}{dx}(\csc x) = -\csc x \cot x$	$\frac{d}{dx}(\csc f(x)) = -f'(x)\csc f(x)\cot f(x)$
$\frac{d}{dx}(\sec x) = \sec x \tan x$	$\frac{d}{dx}(\sec f(x)) = f'(x)\sec f(x)\tan f(x)$
$\frac{d}{dx}(\cot x) = -\csc^2 x$	$\frac{d}{dx}(\cot f(x)) = -f'(x)\csc^2 f(x)$

EXPONENTIAL FUNCTION

STANDARD FORM	GENERAL FORM
$\frac{d}{dx}e^x = e^x$	$\frac{d}{dx}e^{f(x)} = f'(x)e^{f(x)}$

LOGARITHMIC FUNCTION

STANDARD FORM	GENERAL FORM
$\frac{d}{dx}\ln x = \frac{1}{x}$	$\frac{d}{dx}\ln f(x) = \frac{f'(x)}{f(x)}$

INTEGRATION

STANDARD FORM	GENERAL FORM Where : $f(x)=ax+b$
$\int \cos x\, dx = \sin x + c$	$\int \cos f(x) dx = \frac{\sin f(x)}{f'(x)} + c$
$\int \sin x\, dx = -\cos x + c$	$\int \sin f(x) dx = \frac{-\cos f(x)}{f'(x)} + c$
$\int \sec^2 x\, dx = \tan x + c$	$\int \sec^2 f(x) dx = \frac{\tan f(x)}{f'(x)} + c$
$\int \sec x \tan x\, dx = \sec x + c$	$\int \sec f(x) \tan f(x) dx = \frac{\sec f(x)}{f'(x)} + c$
$\int \csc x \cot x\, dx = -\csc x + c$	$\int \csc f(x) \cot f(x) dx = \frac{-\csc f(x)}{f'(x)} + c$
$\int \csc^2 x\, dx = -\cot x + c$	$\int \csc^2 f(x) dx = \frac{-\cot f(x)}{f'(x)} + c$

EXPONENTIAL FUNCTION

STANDARD FORM	GENERAL FORM Where : $f(x)=ax+b$
$\int e^x dx = e^x + c$	$\int e^{f(x)} dx = \frac{e^{f(x)}}{f'(x)} + c$

LOGARITHMIC FUNCTION

STANDARD FORM	GENERAL FORM Where : $f(x)=ax+b$
$\int \frac{1}{x} dx = \ln\lvert x\rvert + c$	$\int \frac{1}{f(x)} dx = \frac{\ln\lvert f(x)\rvert}{f'(x)} + c$

INTEGRATION BY PART

$\int u\, dv = uv - \int v\, du$