UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF MARINE ENGINEERING TECHNOLOGY

FINAL EXAMINATION
SEPTEMBER 2016 SEMESTER

COURSE CODE	: LGB10403
COURSE NAME	: ENGINEERING MATHEMATICS 2
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	: BACHELOR
DATE	: 23 JANUARY 2017
TIME	: 9.00AM – 12.00PM
DURATION	: 3 HOURS

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 THREE (3) questions ONLY.
5. Please write your answers on the answer booklet provided.
6. Answer all questions in English language ONLY.
7. Formula has been appended for your reference.

THERE ARE 5 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

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

Question 1

Show that the equation of the tangent line for the curve, $x^2 - xy + y^2 = 3$ at the point (1,2) is $y = 2$.

(5 marks)

Question 2

Solve $\frac{dy}{dx}$ for $x = t^3 + t$ and $y = t^7 = t - 1$.

(5 marks)

Question 3

If $y = \tan^{-1}(2x - 1)$, differentiate y with respect to x.

(5 marks)

Question 4

Use integration by parts to integrate $x \sin x$.

(5 marks)

Question 5

Given that $y = -\frac{3}{p^2}$, obtain the approximate change in the value of y if p decreases at the rate from 1 to 0.98.

(5 marks)

Question 6

Given $Z_1 = 0.25 - 0.4i$ and $Z_2 = -0.33 + 0.45i$. Determine :

(a) $Z_1 \cdot Z_2$

(3 marks)

(b) $\overline{Z_2} - Z_1$

(2 marks)

Question 7

The vertical position of a ball is given by $y(t) = -16t^2 + 96t + 50$. Calculate the maximum height, the ball will reach.

(5 marks)

Question 8

Find the inverse Laplace Transform of $F(s) = \frac{3}{s+2}$.

(5 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer THREE questions ONLY.
Please use the answer booklet provided.

Question 9

(a) If $\frac{x^4-4x^2+x+1}{x^2-4} = x^2 + \frac{A}{x+2} + \frac{B}{x-2}$. Find the value of A and B.

(15 marks)

(b) Hence, evaluate the integral $\int \frac{x^4-4x^2+x+1}{x^2-4} dx$.

(5 marks)

Question 10

(a) The area of expanding rectangle is increasing at the rate of 48 centimeters square per second. The length of the rectangle is always equal to the square of its width (in centimeters). Determine the rate of the length increasing at the instant when the width is 2 cm.

(8 marks)

(b) A poster is to have an area of 300 m^2, with margin of 6 m each, top and bottom, and 2 m on the sides. Calculate the dimensions that will give the largest printed area.

(12 marks)

Question 11

Given that $Z_1 = 2 - 2\sqrt{3}i$ and $Z_2 = \sqrt{3} - i$.

(a) Express $(Z_1)^5$ in trigonometric form.

(8 marks)

(b) Prove that $\overline{Z_1 \cdot Z_2} = \overline{Z_1} \cdot \overline{Z_2}$.

(6 marks)

(c) Hence, determine $\dfrac{\overline{Z_2}}{Z_1 \cdot Z_2}$.

(6 marks)

Question 12

Given the differential equation, $\left(x^2 - 3y^2\right)dx + 2xydy = 0$.

(a) Rewrite the equation in form of $\dfrac{dy}{dx}$.

(2 marks)

(b) Hence, find the general solution for the differential equation.

(14 marks)

(c) If $y(-1) = -3$, write the equation in particular form

(4 marks)

END OF EXAMINATION PAPER

FORMULA SHEET

TRIGONOMETRY IDENTITIES

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

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

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

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

Differentiation of Inverse Trigonometric Functions

$\frac{d}{dx}\sin^{-1}u = \frac{1}{\sqrt{1-u^2}}\frac{du}{dx}$
$\frac{d}{dx}\cos^{-1}u = -\frac{1}{\sqrt{1-u^2}}\frac{du}{dx}$
$\frac{d}{dx}\tan^{-1}u = \frac{1}{1+u^2}\frac{du}{dx}$
$\frac{d}{dx}\cot^{-1}u = -\frac{1}{1+u^2}\frac{du}{dx}$
$\frac{d}{dx}\sec^{-1}u = \frac{1}{\lvert u\rvert\sqrt{u^2-1}}\frac{du}{dx}$
$\frac{d}{dx}\csc^{-1}u = -\frac{1}{\lvert u\rvert\sqrt{u^2-1}}\frac{du}{dx}$

Differentiation of Hyperbolic Functions

$\frac{d}{dx}(\sinh u) = \cosh u\frac{du}{dx}$
$\frac{d}{dx}(\cosh u) = \sinh u\frac{du}{dx}$
$\frac{d}{dx}(\tanh u) = \operatorname{sech}^2 u\frac{du}{dx}$
$\frac{d}{dx}(\coth u) = -\operatorname{csch}^2 u\frac{du}{dx}$
$\frac{d}{dx}(\operatorname{sech} u) = \operatorname{sech} u\tanh u\frac{du}{dx}$
$\frac{d}{dx}(\operatorname{csch} u) = -\operatorname{csch} u\coth u\frac{du}{dx}$

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

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

Table of Laplace Transforms

	$f(t)=\mathcal{L}^{-1}\{F(s)\}$	$F(s)=\mathcal{L}\{f(t)\}$		$f(t)=\mathcal{L}^{-1}\{F(s)\}$	$F(s)=\mathcal{L}\{f(t)\}$
1.	1	$\frac{1}{s}$	2.	e^{at}	$\frac{1}{s-a}$
3.	$t^n,\quad n=1,2,3,\ldots$	$\frac{n!}{s^{n+1}}$	4.	$t^p,\ p>-1$	$\frac{\Gamma(p+1)}{s^{p+1}}$
5.	$\sqrt{t}$	$\frac{\sqrt{\pi}}{2s^{\frac{3}{2}}}$	6.	$t^{n-\frac{1}{2}},\quad n=1,2,3,\ldots$	$\frac{1\cdot3\cdot5\cdots(2n-1)\sqrt{\pi}}{2^n s^{n+\frac{1}{2}}}$
7.	$\sin(at)$	$\frac{a}{s^2+a^2}$	8.	$\cos(at)$	$\frac{s}{s^2+a^2}$
9.	$t\sin(at)$	$\frac{2as}{(s^2+a^2)^2}$	10.	$t\cos(at)$	$\frac{s^2-a^2}{(s^2+a^2)^2}$
11.	$\sin(at)-at\cos(at)$	$\frac{2a^3}{(s^2+a^2)^2}$	12.	$\sin(at)+at\cos(at)$	$\frac{2as^2}{(s^2+a^2)^2}$
13.	$\cos(at)-at\sin(at)$	$\frac{s(s^2-a^2)}{(s^2+a^2)^2}$	14.	$\cos(at)+at\sin(at)$	$\frac{s(s^2+3a^2)}{(s^2+a^2)^2}$
15.	$\sin(at+b)$	$\frac{s\sin(b)+a\cos(b)}{s^2+a^2}$	16.	$\cos(at+b)$	$\frac{s\cos(b)-a\sin(b)}{s^2+a^2}$
17.	$\sinh(at)$	$\frac{a}{s^2-a^2}$	18.	$\cosh(at)$	$\frac{s}{s^2-a^2}$
19.	$e^{at}\sin(bt)$	$\frac{b}{(s-a)^2+b^2}$	20.	$e^{at}\cos(bt)$	$\frac{s-a}{(s-a)^2+b^2}$
21.	$e^{at}\sinh(bt)$	$\frac{b}{(s-a)^2-b^2}$	22.	$e^{at}\cosh(bt)$	$\frac{s-a}{(s-a)^2-b^2}$
23.	$t^n e^{at},\quad n=1,2,3,\ldots$	$\frac{n!}{(s-a)^{n+1}}$	24.	$f(ct)$	$\frac{1}{c}F\left(\frac{s}{c}\right)$
25.	$u_c(t)=u(t-c)$ Heaviside Function	$\frac{e^{-cs}}{s}$	26.	$\delta(t-c)$ Dirac Delta Function	e^{-cs}
27.	$u_c(t)f(t-c)$	$e^{-cs}F(s)$	28.	$u_c(t)g(t)$	$e^{-cs}\mathcal{L}\{g(t+c)\}$
29.	$e^{ct}f(t)$	$F(s-c)$	30.	$t^n f(t),\quad n=1,2,3,\ldots$	$(-1)^n F^{(n)}(s)$
31.	$\frac{1}{t}f(t)$	$\int_s^\infty F(u)\,du$	32.	$\int_0^t f(v)\,dv$	$\frac{F(s)}{s}$
33.	$\int_0^t f(t-\tau)g(\tau)\,d\tau$	$F(s)G(s)$	34.	$f(t+T)=f(t)$	$\frac{\int_0^T e^{-st}f(t)\,dt}{1-e^{-sT}}$
35.	$f'(t)$	$sF(s)-f(0)$	36.	$f''(t)$	$s^2F(s)-sf(0)-f'(0)$
37.	$f^{(n)}(t)$	$s^nF(s)-s^{n-1}f(0)-s^{n-2}f'(0)\cdots-sf^{(n-2)}(0)-f^{(n-1)}(0)$			