UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF MARINE ENGINEERING TECHNOLOGY

FINAL EXAMINATION
SEPTEMBER 2016 SEMESTER

COURSE CODE	: LGB 10303
COURSE NAME	: ENGINEERING MATHEMATICS 1
PROGRAMME NAME	: BACHELOR
DATE	: 18 JANUARY 2017
TIME	: 9.00 AM – 12.00 PM
DURATION	: 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
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 in the answer booklet provided.
6. Answer all questions in English.
7. Answers should be written in blue or black ink except for sketching, graphic and illustration.

THERE ARE 6 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

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

Question 1

A concrete mixture contains seven parts by volume of ballast, four parts by volume of sand and two parts by volume of cement. Calculate:

(a) the percentage of each of these three constituents correct to the nearest 1%.

(b) the mass of cement in a two tonne dry mix, correct to 1 significant figure.

(8 marks)

Question 2

(a) State the types of roots for the following cases:

i. $b^2 - 4ac < 0$

ii. $b^2 - 4ac = 0$

iii. $b^2 - 4ac > 0$

(3 marks)

(b) If one of the factors of the equation $x^2 + 8x + p = 0$ is 3 times of another factor, interpret the value of p.

(5 marks)

Question 3

Simplify the following equations:

(a) $\dfrac{\sqrt[3]{54x^5}}{\sqrt[3]{2x^2}}$

(3 marks)

(b) $\dfrac{\log_5 8 \times \log_3 25}{\log_{\sqrt{3}} 4}$

(5 marks)

Question 4

Prove each trigonometric identity:

(a) $\cos(x+y)\cos(x+y) = (\cos x \cos y)^2 - (\sin x \sin y)^2$

(2 marks)

(b) $\dfrac{\sin(x-y)}{\cos x \cos y} = \tan x - \tan y$

(3 marks)

(c) $\cos\left(x+\dfrac{\pi}{6}\right) - \sin\left(x+\dfrac{2\pi}{3}\right) = 0.$

(3 marks)

Question 5

By using suitable rules, solve the following integrals:

(a) $\int\left(\dfrac{4x^2 - \sqrt[3]{x} + 6x^5}{x^4}\right)dx$

(4 marks)

(b) $\dfrac{d}{dx}\left(\dfrac{4\sin 5x}{5x^4}\right)$

(4 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer THREE(3) questions only.
Please use the answer booklet provided.

Question 6

Two cubic polynomials are defined by $f(x) = x^3 + (a-3)x + 2b$ and $g(x) = 3x^3 + x^2 + 5ax + 4b$, where a and b are constants.

(a) Given that f(x) and g(x) have a common factor of (x-2), show that a = - 4.

(8 marks)

(b) Find the value of b.

(2 marks)

(c) Using the values of a and b, factorise f(x) fully.

(5 marks)

(d) Hence, show that f(x) and g(x) have two common factors.

(5 marks)

Question 7

(a) Show that $\log_y x = \frac{1}{\log_x y}$.

(2 marks)

(b) Evaluate the possible values of x that satisfy $2(\log_9 x + \log_x 9) = 5$.

(8 marks)

(c) Show that $9\sinh x - \cosh x = 4e^x - 5e^{-x}$.

(3 marks)

(d) Given that $9\sinh x - \cosh x = 8$. Find the exact value of tanh x.

(7 marks)

Question 8

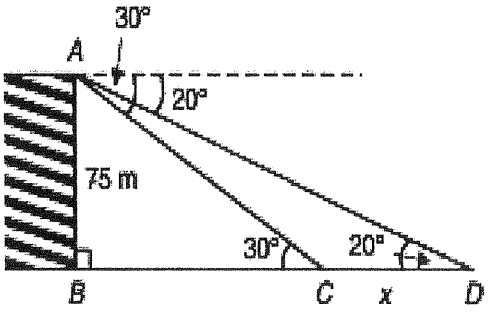

Figure 1

(a) Figure 1 shows the angle of depression of a ship viewed at a particular instant from the top of a 75m vertical cliff is 30^0.

i. Find the distance of the ship from the base of the cliff at this instant.

(2 marks)

ii. The ship is sailing away from the cliff at constant speed and 1 minute later its angle of depression from the top of the cliff is 20^0 . Determine the speed of the ship in km/h.

(8 marks)

(b) Given $y = \frac{1}{2}\cos 3(x + \pi)$.

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

(4 marks)

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

(6 marks)

Question 9

(a) Determine the slope of the tangent to the graph of $f(x)=\frac{\sqrt{x}}{2}$. by using:

i. basic rule

(2 marks)

ii. definition of derivative

(8 marks)

(b) Evaluate:

i. $\int\left(\sqrt{1-x}+\frac{1}{\sqrt{1-x}}-\frac{1}{(1-x)^2}\right)dx$.

(3 marks)

ii. $\int\left(e^{(\sin^2(\tan x))}\right)dx$.

(3 marks)

iii. $\int\left(\frac{3}{4-6\theta}-2\sec\left(\frac{\pi}{2}-9\theta^2\right)\tan\left(\frac{\pi}{2}-9\theta^2\right)\right)d\theta$.

(4 marks)

END OF EXAMINATION PAPER

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

HYPERBOLIC FUNCTION

$\cosh x = \frac{e^x + e^{-x}}{2}$
$\sinh x = \frac{e^x - e^{-x}}{2}$
$\tanh x = \frac{e^x - e^{-x}}{e^x + e^{-x}}$

TRIGONOMETRIC IDENTITIES

$\sin(x \pm y) = \sin x \cos y \pm \cos x \sin y$
$\cos(x \pm y) = \cos x \cos y \mp \sin x \sin y$