UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF MARINE ENGINEERING TECHNOLOGY

FINAL EXAMINATION
JANUARY 2016 SEMESTER

COURSE CODE	: LGB 10403
COURSE NAME	: ENGINEERING MATHEMATICS 2 (R)
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	: BACHELOR
DATE	: 25 MAY 2016
TIME	: 09.00 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. Answer should be written in blue or black ink except for sketching, graphic and illustrations.

THERE ARE 7 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

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

Question 1

Determine $\frac{dy}{dx}$ for the following:

(a) $y = e^x - \frac{1}{e^{2x}}$.

(2 marks)

(b) $y = \sin\left(\frac{1}{2}x + 4\right) - \tan(6 - 5x^2)$.

(3 marks)

(b) $\sqrt{x} + \sqrt{y} = 200$.

(5 marks)

Question 2

Evaluate the following integral equation:

(a) $\int \frac{x+1}{\sqrt{x}} dx$.

(3 marks)

(b) $\int x(x+1)^2 dx$.

(3 marks)

(c) $\int \sin x \cos^2 x dx$.

(4 marks)

Question 3

Determine the general solution of the differential equation:

(a) $\frac{dy}{dx} = x + \cos x$.

(2 marks)

(b) $\frac{1}{x}\frac{dy}{dx} = \frac{1}{x^2 - 1}$.

(5 marks)

(c) $x\frac{dx}{dt} = t + 2$.

(3 marks)

Question 4

The data below shows the marks scored by ten students in Engineering Mathematics test.

65 85 80 80 75 90 60 55 76 86

Determine:

(a) Mean, median and mode.

(5 marks)

(b) Range, interquartile range and quartile deviation.

(5 marks)

SECTION B (Total: 60 marks)

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

Question 5

(a) A sheet of cardboard 3 ft. by 4 ft. will be made into a box by cutting equal-sized squares from each corner and folding up the four edges as shown in Figure 1. Determine the dimensions of the box with the largest volume?

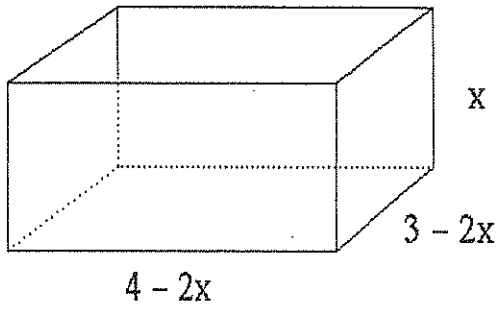

Figure 1

(9 marks)

(b) An inverted cone with height 20 meters and radius 5 meters is being filled with a hose which pumps in water at the rate of 3 cubic meters per minute. When the water level is 2 meters, determine : (HINT: $V = \frac{1}{3}\pi r^2 h$)

i. How fast is the water level rising?

ii. How fast is the radius changing at this moment?

(11 marks)

Question 6

(a) Evaluate $\int \frac{x^2+1}{x^2-1} dx$.

(9 marks)

(b)

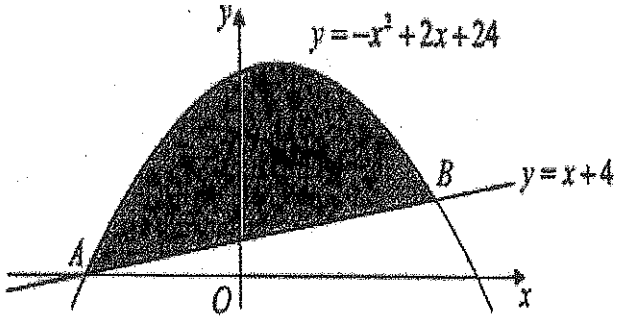

Figure 2

A straight line with equation $y=x+4$ cuts the curve with equation $y=-x^2+2x+24$ at the points A and B, as shown in Figure 2.

i. Find the coordinates of A and B.

ii. The finite region R is bounded by the straight line and the curve in Figure 2. Evaluate the area of R.

(11 marks)

Question 7

(a) Determine the particular solution of $\frac{dy}{d\theta} = \sec\theta + y\tan\theta$ using linear differential equation method given that the boundary conditions y=1 when $\theta = 0$.

(9 marks)

(b) The equation of motion of a body oscillating on the end of a spring is $\frac{d^2x}{dt^2} + 100x = 0$ where x is the displacement of the body from its equilibrium position after t seconds in metres. Evaluate x in terms of t given that at t = 0, x = 2m and $\frac{dx}{dt} = 0$.

(11 marks)

Question 8

The age distributions for a sample of small ships in a Company XYZ is shown in Table 1.

Age (months)	Number of small ships
21 - 25	10
26 – 30	35
31 – 35	16
36 – 40	14
41 – 45	12
46 – 50	10
51 – 55	3

Table 1

(a) Produce a frequency distribution (including class interval) and calculate the mean of age and standard deviation of the small ships.

(6 marks)

(b) Construct a histogram on a graph paper and determine the shape of the distribution.

(6 marks)

(c) From the histogram, identify the modal value and interpret the value.

(2 marks)

(d) Determine the coefficient of skewness for the distribution and interpret the result.

(Coefficient of skewness= $\frac{mean - \mathrm{mod}\, e}{s\tan dard\ deviation}$).

(4 marks)

(e) Calculate the coefficient of variation for the sample of small ships.

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

HYPERBOLIC FUNCTION

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

STATISTICS

Mean:

$$\overline{x} = \frac{\sum_i f_i x_i}{\sum_i f_i} = \frac{\sum_i f_i x_i}{n}$$

Mode:

$$= L + \left[\frac{a}{a+b}\right] c$$

Median:

$$= L + \left[\frac{\frac{N}{2} - f_L}{f_m}\right] c$$

Ungroup data:

$$Variance: s^2 = \frac{\sum_i (x_i - \overline{x})^2}{n-1} \quad \text{or} \quad s^2 = \frac{\sum_i x_i^{\,2} - \frac{\left(\sum_i x_i\right)^2}{n}}{n-1}$$

Grouped data:

Variance:

$$s^2 = \frac{\sum_{i=1}^{n} x_i^{\,2} f - \frac{\left(\sum_{i=1}^{n} x_i f\right)^2}{n}}{n-1}$$