UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	TECHNICAL MATHEMATICS II
COURSE CODE	:	DAS 11103
PROGRAMME	:	DAK / DAJ
EXAMINATION DATE	:	JUNE 2017
DURATION	:	3 HOURS
INSTRUCTION	:	PART A) ANSWER **ALL** QUESTIONS PART B) ANSWER **THREE (3)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

PART A

Q1 (a) Explain about improper integral and give example.

(3 marks)

(b) Given two curves, $y = x^2 + 2$ and $y = x + 4$.

(i) Sketch the region that enclosed by both curves. Include all intersection points.

(5 marks)

(ii) Hence, calculate the area of the bounded region.

(6 marks)

(c) Use cylindrical shells to find the volume of the solid that results when the region enclosed by $y = 2x$ and $y^2 = 4x$ is revolved about the $x-$ axis. Refer **Figure Q1(c)**.

(6 marks)

Q2 (a) Evaluate the following:

(i) $$\int \left(\frac{3x^2 + 4e^x - 6\sqrt{x}}{2} \right) dx.$$

(3 marks)

(ii) $$\int_{\pi/2}^{\pi} (\sin 2\theta - \cos\theta) d\theta.$$

(3 marks)

(b) By using substitution method, find

$$\int \frac{4x}{(5x+3)^2} dx.$$

(7 marks)

(c) By using Trapezoidal's rule, solve the following integral with $n = 12$. Write the answer to 3 decimal places

$$\int_1^4 \frac{5x+3}{(2x-9)^2} dx.$$

(7 marks)

PART B

Q3 (a) Calculate the following:

(i) $\int_0^8 \frac{1}{x+4}dx.$

(3 marks)

(ii) $\int \frac{5x+4}{x^7}dx.$

(3 marks)

(b) Evaluate the definite integral $\int_4^9 \left(\sqrt{x} - \frac{1}{\sqrt{x}}\right)dx$.

(4 marks)

(c) Use $n = 8$ subdivisions to approximate the value of $\int_0^2 \sqrt[3]{x^2+7x}\ dx$ by using Simpson's rule. Express your answer to at least four decimal places.

(10 marks)

Q4 (a) Find all the critical points for the function below:

(i) $y = x^4 - 8x^2 + 7.$

(4 marks)

(ii) $y = 4x^3 - 6x^2 - 72x + 2.$

(3 marks)

(b) The radius of circle is increasing at the rate $6cm\,s^{-1}$. Area of circle is $A = \pi r^2$.

(i) Find the rate of change of the area of the circle when its radius is 18cm.

(4 marks)

(ii) Find the radius of the circle when the area is increasing at the rate of $120\pi\, cm^2\, s^{-1}$.

(3 marks)

(c) By using L'Hôpital's Rule, find:

(i) $\lim_{x\to\pi} \frac{\sin 5x}{3x}.$

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(3 marks)

(ii) $\lim_{x\to 3} \frac{x^2+2x-15}{x-3}.$

(3 marks)

Q5 (a) Find $\frac{dy}{dx}$ for the following equations:

(i) $y = \cos^{-1} x + \frac{30}{\sqrt{x}}$.

(3 marks)

(ii) $y = \frac{2x^2 + 5x + 3}{2x + 3}$.

(3 marks)

(b) By using product rule, differentiate

$$y = 2x(x^2 - 1)^5.$$

(4 marks)

(c) By using implicit differentiation, differentiate

$$5y^2 + 8\sin x = 7y\sin x + e^x y^2.$$

(5 marks)

(d) A curve is given by a parametric equation,

$$y = (4t - 3)\sin t \text{ and } x = t^2 - 2t.$$

(i) Find $\frac{dy}{dx}$ by using parametric differentiation.

(3 marks)

(ii) Evaluate $\frac{dy}{dx}$ when $t = 2$.

(2 marks)

Q6 (a) Compute the following limits:

(i) $\lim_{x \to 3} 8x^2 + x - 4$.

(2 marks)

(ii) $\lim_{x \to 1} \frac{x - 1}{\sqrt{x} - 1}$.

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(4 marks)

(iii) $\lim_{x \to 8} \frac{x^2 - 4x - 32}{x - 8}$.

(3 marks)

(b) Based on **Figure Q6(b)**, find the limit of *g(x)* if exist.

(i) $\lim_{x\to 2^+} g(x)$, $\lim_{x\to 2^-} g(x)$ and $\lim_{x\to 2} g(x)$

(3 marks)

(ii) $\lim_{x\to -1^+} g(x)$, $\lim_{x\to -1^-} g(x)$ and $\lim_{x\to -1} g(x)$

(3 marks)

(c) Given: $h(x)=\begin{cases} kx, & x<4 \\ x^3-3x+4, & x\geq 4 \end{cases}$

Find k so that $h(x)$ is continuous at every value of x.

(5 marks)

Q7 (a) Find the domain and range for the following functions:

(i) $f(x)=\left|-2x-1\right|+4.$

(4 marks)

(ii) $f(x)=2\sin(3x-1)+3.$

(4 marks)

(b) Given $f(x)=\dfrac{2x^2}{3}$ and $g(x)=\sqrt[3]{3x+6}$.

(i) Find $f\circ g(x)$.

(2 marks)

(ii) Find the inverse of function for $f(x)$ and $g(x)$.

(6 marks)

(ii) Find $f\circ g^{-1}\circ f^{-1}(1)$.

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(4 marks)

-END OF QUESTIONS-

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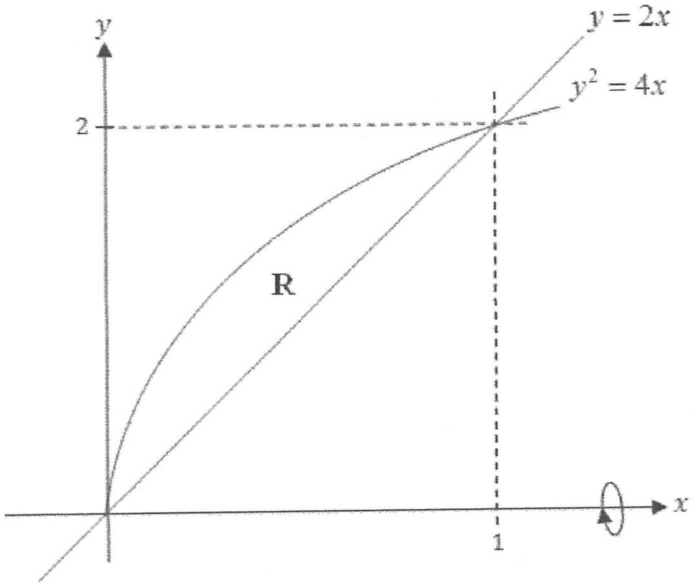

Figure Q1(c)

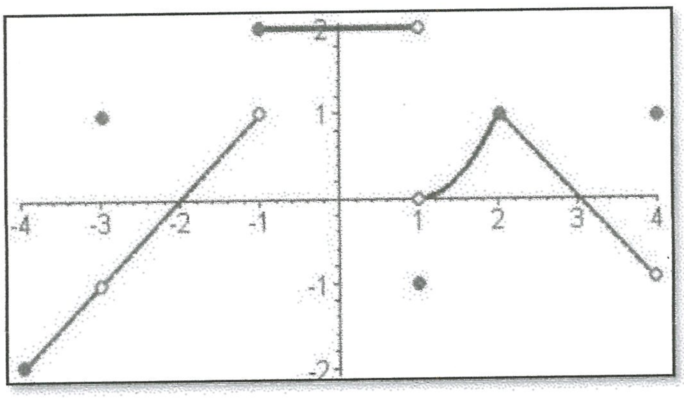

Figure Q6(b)

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FORMULAE

Table 1: Differentiation

$\frac{d}{dx}(ax^n) = nax^{n-1}$	$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$
$\frac{d}{dx}(e^x) = e^x$	$\frac{dy}{dx} = \frac{dy}{dm} \cdot \frac{dm}{dn} \cdot \frac{dn}{dx}$
$\frac{d}{dx}(e^{ax+b}) = ae^{ax+b}$	$\frac{d}{dx}(\sin x) = \cos x$
$\frac{d}{dx}(a^x) = a^x \ln a$	$\frac{d}{dx}(\cos x) = -\sin x$
$\frac{d}{dx}(\ln x) = \frac{1}{x}$	$\frac{d}{dx}(\tan x) = \sec^2 x$
$\frac{d}{dx}(\log_b x) = \frac{1}{x}\log_b e$	$\frac{d}{dx}(\text{cosec } x) = -\text{cosec } x \cdot \cot x$
$\frac{d}{dx}(uv) = uv' + vu'$	$\frac{d}{dx}(\cos^{-1} x) = -\frac{1}{\sqrt{1-x^2}}$
$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{vu' - uv'}{v^2}$	$\frac{d}{dx}(\cot x) = -\text{cosec}^2 x$

Table 2: Integration

$\int k\,dx = kx + C$	$\int e^x\,dx = e^x + C$
$\int x^n\,dx = \frac{x^{n+1}}{n+1} + C$	$\int e^{ax+b}\,dx = \frac{e^{ax+b}}{a} + C$
$\int \frac{1}{x}\,dx = \ln x + C$	$\int \sin x\,dx = -\cos x + C$
	$\int \cos x\,dx = \sin x + C$
Definite Integral	**Integration by Parts**
$\int_a^b f(x)\,dx = F(b) - F(a)$	$\int u\,dv = uv - \int v\,du$

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Table 3: Integration

Trapezoidal Rule

$$\int_a^b f(x)\,dx \approx \frac{h}{2}\left[f(a)+f(b)+2\sum_{i=1}^{n-1} f(a+ih)\right]$$

Simpson Rule

$$\int_a^b f(x)\,dx \approx \frac{h}{3}\left[f(a)+f(b)+4\sum_{\substack{i=1\\ i\text{ odd}}}^{n-1} f(a+ih)+2\sum_{\substack{i=1\\ i\text{ even}}}^{n-1} f(a+ih)\right]$$

Area

$$A=\int_a^b [f(x)-g(x)]\,dx$$

$$A=\int_c^d [f(y)-g(y)]\,dy$$

Volume in Cylindrical Shells

$$V=2\pi\int_a^b x[f(x)-g(x)]\,dx$$

$$V=2\pi\int_c^d y[f(y)-g(y)]\,dy$$

Arc Length

$$L=\int_a^b \sqrt{1+\left(\frac{dy}{dx}\right)^2}\,dx$$

$$L=\int_c^d \sqrt{1+\left(\frac{dx}{dy}\right)^2}\,dy$$

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