Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	TECHNICAL MATHEMATICS II
COURSE CODE	:	DAS 11103
PROGRAMME	:	1 DAB /1 DAJ /1 DAR / 1 DAK
EXAMINATION DATE	:	JUNE 2015 / JULY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	A) ANSWER ALL QUESTIONS IN **PART A** B) ANSWER **THREE (3)** QUESTIONS IN **PART B**

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

PART A

Q1 (a) From **Figure Q1 (a)**, find the area of the region enclosed by the curve

$$y = 2 + x - x^2 \text{ and } y = -x - 1$$

(7 marks)

(b) 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 $y-$ axis.
Refer **Figure Q1 (b)**.

(6 marks)

(c) Find the arc length of the curve $y = \frac{1}{3}(x^2 + 2)^{3/2}$ from $x = -1$ to $x = 1$.

(7 marks)

Q2 (a) Evaluate

(i) $\int \left(\frac{3x^2 + 5\sqrt{x}}{3\sqrt{x}} \right) dx$

(3 marks)

(ii) $\int \left(x\left(5x^3 - \frac{\sin x}{x} \right) \right) dx$

(2 marks)

(iii) $\int_1^3 \left(x^2 (1 - 2x) \right) dx$

(4 marks)

(b) By using a suitable technique of integration, evaluate

(i) $\int \left(\frac{7x - 1}{x^2 - 2x - 3} \right) dx$

(6 marks)

(ii) $\int_{-1}^{1} \left(12x^2 (2x^3 + 5)^3 \right) dx$

(5 marks)

PART B

Q3 (a) Solve the following integral by using Simpson's rule, using $h = 0.25$. Write the answer to 3 decimal places

$$\int_0^2 \frac{2}{3+\sqrt{x}}\,dx$$

(6 marks)

(b) Evaluate the following integral by using substitution

$$\int_0^{\frac{\pi}{4}} \frac{9\sec^2 x - 6x}{3\tan x - x^2}\,dx$$

(7 marks)

(c) Evaluate by using integration by parts

$$\int 2x^3 \ln x\,dx$$

(7 marks)

Q4 (a) Given $f(x) = \begin{cases} 1 & , x < -1 \\ 3 - 2x^2 & , -1 \le x < 3. \\ 4x - 20 & , x \ge 3 \end{cases}$

(i) Sketch the piecewise function of $f(x)$.

(3 marks)

(ii) State the domain and range of $f(x)$.

(2 marks)

(iii) Find the value of $f(x)$ when $x = -2, 3, 6$ and ∞.

(6 marks)

(b) Given $g(x) = 5 - \frac{1}{x}$.

(i) Find the inverse function of $g(x)$.

(3 marks)

(ii) Sketch the inverse function of $g(x)$.

(2 marks)

(iii) State the domain and range of inverse function of $g(x)$.

(2 marks)

(iv) When $h(x) = \sqrt{2x}$, find $g \circ h$.

(2 marks)

Q5 (a) Compute the following limits.

(i) $\lim_{x \to 9} \frac{2x - 18}{\sqrt{x} - 3}$

(4 marks)

(ii) $\lim_{y \to \infty} 2y \cos\left(\frac{1}{y}\right)$

(4 marks)

(iii) $\lim_{z \to 2} \frac{(z-1)(z-2)^2}{z^3 - 4z^2 + 4z}$

(4 marks)

(b) Determine the value of a so that

$$f(x) = \begin{cases} ax + 1 \ , & x \leq 3 \\ ax^2 - 1 \ , & x > 3 \end{cases}.$$

is continuous for any value of x.

(5 marks)

(c) Find the value of x so that

$$f(x) = \frac{2}{|x^3 - 27|} + 5x$$

is discontinuous.

(3 marks)

Q6 (a) Differentiate

(i) $y = 2x^3 - \frac{1}{\sqrt{x}}$

(3 marks)

(ii) $y = 2x \sin x^3$

(4 marks)

(iii) $y = \ln \sin^2 4x$

(5 marks)

(b) Given $x = \frac{2-3t}{1+t}$ and $y = \frac{3+2t}{1+t}$. Find $\frac{dy}{dx}$.

(4 marks)

(c) Find $\frac{dy}{dx}$ when $\sin y + 4xy - 3x - y = 15$.

(4 marks)

Q7 (a) Using L'Hôspital's Rule, find

(i) $\lim_{x \to \pi} \frac{2 - \sin x}{\sin x}$

(3 marks)

(ii) $\lim_{x \to 1} \frac{\ln x}{x^3 - 3x + 2}$

(3 marks)

(b) Sketch the graph of $y = x(x-1)^2$ by considering the concavity, maximum and minimum and points of inflection.

(14 marks)

- END OF QUESTIONS-

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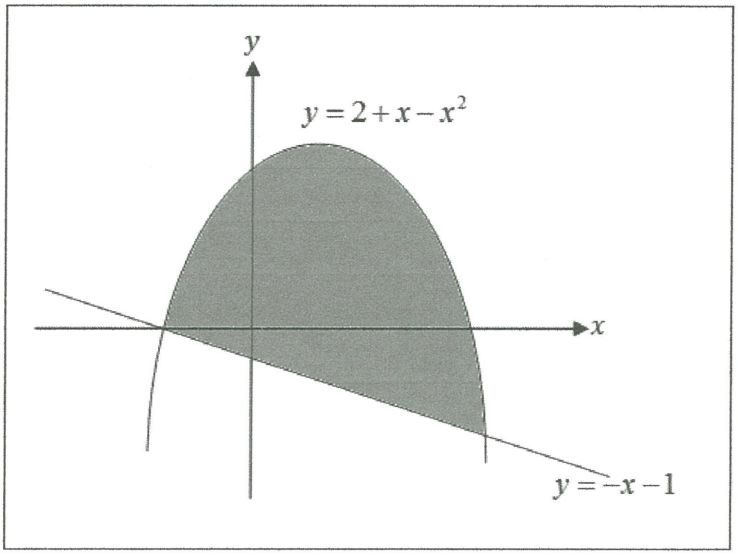

Figure Q1 (a)

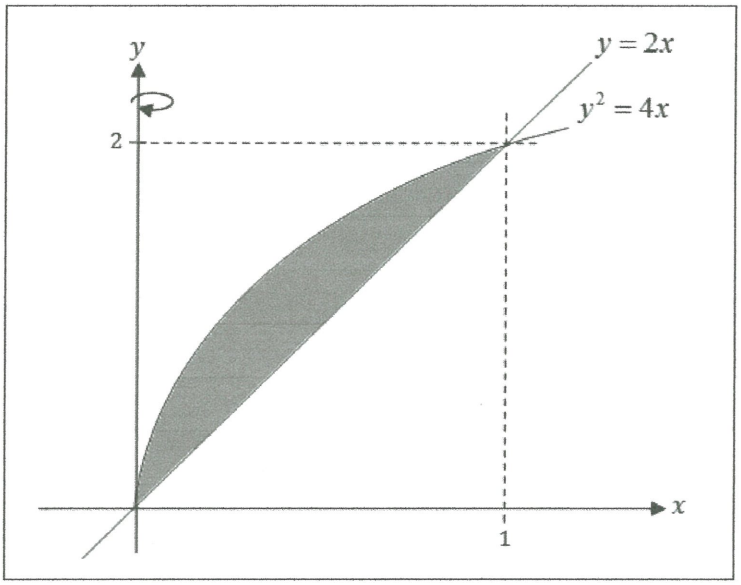

Figure Q1 (b)

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FORMULAE

Table 1: Differentiation

$$\frac{d}{dx}(ax^n) = nax^{n-1}$$

$$\frac{d}{dx}(e^x) = e^x$$

$$\frac{d}{dx}(a^x) = a^x \ln a$$

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

$$\frac{d}{dx}(\log_b x) = \frac{1}{x}\log_b e$$

$$\frac{d}{dx}(uv) = uv' + vu'$$

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{vu' - uv'}{v^2}$$

$$\frac{dy}{dx} = \frac{dy}{du}\cdot\frac{du}{dx}$$

$$\frac{dy}{dx} = \frac{dy}{dm}\cdot\frac{dm}{dn}\cdot\frac{dn}{dx}$$

$$\frac{d}{dx}(\sin x) = \cos x$$

$$\frac{d}{dx}(\cos x) = -\sin x$$

$$\frac{d}{dx}(\tan x) = \sec^2 x$$

$$\frac{d}{dx}(\operatorname{cosec} x) = -\operatorname{cosec} x \cdot \cot x$$

$$\frac{d}{dx}(\sec x) = \sec x \cdot \tan x$$

$$\frac{d}{dx}(\cot x) = -\operatorname{cosec}^2 x$$

Table 2: Integration

$$\int k\,dx = kx + C$$

$$\int x^n\,dx = \frac{x^{n+1}}{n+1} + C$$

$$\int \frac{1}{x}\,dx = \ln x + C$$

$$\int e^x\,dx = e^x + C$$

$$\int \sin x\,dx = -\cos x + C$$

$$\int \cos x\,dx = \sin x + C$$

Definite Integral

$$\int_a^b f(x)\,dx = F(b) - F(a)$$

Integration by Parts

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

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Table 2: 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

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

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