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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016

COURSE NAME	:	ENGINEERING MATHEMATICS I
COURSE CODE	:	DAS 10203
PROGRAMME	:	1 DAA / 1 DAM / 3 DAM
EXAMINATION DATE	:	JUNE 2016 / JULY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	SECTION A ANSWER **ALL** QUESTIONS SECTION B ANSWER **THREE (3)** QUESTIONS ONLY

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

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PART A

Q1 (a) Evaluate

(i) $\int (x^5 + 3e^x + 5\sin x + \sqrt{x})dx.$

(2 marks)

(ii) $\int_4^{+\infty} \frac{2}{x^2 - 1} dx$ (Hint: use partial fraction)

(3 marks)

(b) Using substitution $u = \sqrt{3x+1}$, find $\int \frac{x}{\sqrt{3x+1}} dx.$

(5 marks)

(c) Find $\int e^x \sin x dx$ by using integration by parts.

(5 marks)

(d) The definite integral of $\int_0^1 \frac{1}{x^2+1} dx$ is known to be equal to $\frac{\pi}{4}$. Using the trapezium rule for 5 strips, find an approximation value of π.

(5 marks)

Q2 (a) Sketch the graph and find the area of the region enclosed by the curves $y = x^2$ and $y = 4x$ by integrating with respect to y.

(8 marks)

(b) Use cylindrical shells method to find the volume of the solid generated when the region enclosed by the curves $y = x^3$, $x = 1$, $y = 0$ is revolved about the y-axis.

(6 marks)

(c) Find the arc length of the curve, $y = 3x^{3/2} - 1$ between interval $x = 0$ and $x = 1$.

(6 marks)

PART B

Q3 (a) Given the functions of $f(x) = 2\sqrt{x+3} - 1$ and $g(x) = 4\sin(2x) - 3$.

(i) Sketch the graph of each function.

(6 marks)

(ii) Determine the domain and range of the functions.

(4 marks)

(b) Given functions of $f(x) = \dfrac{x^3+1}{3}$ and $g(x) = \sqrt[3]{x-1}$. Find

(i) the inverse of function for $f(x)$ and $g(x)$

(6 marks)

(ii) the value of $f(2) - g^{-1}(2) + f^{-1}(3)$.

(4 marks)

Q4 (a) Evaluate

(i) $\lim\limits_{x \to -4} \dfrac{x^2 + x - 12}{x^2 + 5x + 4}$

(4 marks)

(ii) $\lim\limits_{x \to 9} \dfrac{3x - 27}{\sqrt{x} - 3} - 2$

(5 marks)

(b) Given piecewise function of $f(x) = \begin{cases} x^2 & ; \quad x < 0 \\ 1 & ; \quad 0 \le x \le 3 \\ -x + 4 & ; \quad x \ge 3 \end{cases}$.

(i) Find $\lim\limits_{x \to 0} f(x)$ and $\lim\limits_{x \to 3} f(x)$.

(6 marks)

(ii) Find $f(0)$ and $f(3)$.

(2 marks)

(iii) Determine whether $f(x)$ is continuous at $x = 0$ and $x = 3$. State the reason.

(3 marks)

Q5 (a) Differentiate the following functions.

(i) $y = \frac{3}{5}x + 12\tan x$.

(2 marks)

(ii) $y = \pi x^{12} - \cos(2x+7)$.

(2 marks)

(iii) $y = \frac{e^{6x}}{\sin(8x+5)}$.

(3 marks)

(b) Given $y = 4\sin t + 2e^{-5t}$ and $x = 25t^4 - \cos t$. Find

(i) $\frac{dx}{dt}$ and $\frac{dy}{dt}$.

(2 marks)

(ii) $\frac{dy}{dx}$ by using the parametric differentiation.

(2 marks)

(c) Find

(i) $\frac{d}{dx}(2x\cos x)$.

(2 marks)

(ii) $\frac{d}{dx}(x^2 y)$.

(2 marks)

(iii) the implicit differentiation for $4y^3 - 2x\cos x = 5x^2 y$.

(5 marks)

Q6 (a) By using L' Hôpital's Rule, calculate

(i) $\lim_{x\to 7}\dfrac{x^2-4x-21}{35-5x}$.

(3 marks)

(ii) $\lim_{x\to 0}\dfrac{10x^5-123x}{3x(7-6x)}$.

(3 marks)

(iii) $\lim_{x\to\infty}\dfrac{11x^3-2\sqrt{x}-\sqrt{19}}{3x^4+5x^3-22x^2}$.

(4 marks)

(b) Given a function, $f(x)=6x^3-29x^2-3x+10$.

(i) Find $f'(x)$ and $f''(x)$.

(2 marks)

(ii) Find the critical points.

(3 marks)

(iii) Determine the minimum and maximum points of the function.

(5 marks)

Q7 (a) Find the approximate value (to three decimal places) of

(i) $\int_1^4 \dfrac{1}{2x+3}\,dx$ using trapezoidal rule by taking step size $h=0.5$.

(8 marks)

(ii) $\int_1^5 \dfrac{x}{x+1}\,dx$ using one third $\left(\dfrac{1}{3}\right)$, Simpson's Rule by taking $n=8$ subintervals.

(8 marks)

(b) The sides of a rectangular metal plate is x cm and y cm respectively. When heated, x and y expanded at a rate of 2 cm/s and 3 cm/s. Find the rate change of the rectangle area when x = 10 cm and y = 8 cm.

(4 marks)

– END OF QUESTION –

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Formula

Table 1 : Differentiation

$\frac{d}{dx}[c]=0$	$\frac{d}{dx}[\sin u]=\cos u\left(\frac{du}{dx}\right)$
$\frac{d}{dx}[x^n]=nx^{n-1}$	$\frac{d}{dx}[\cos u]=-\sin u\left(\frac{du}{dx}\right)$
$\frac{d}{dx}[cu]=c\frac{du}{dx}$	$\frac{d}{dx}[\ln\|u\|]=\frac{1}{u}\left(\frac{du}{dx}\right)$
$\frac{d}{dx}[u\pm v]=\frac{du}{dx}\pm\frac{dv}{dx}$	$\frac{d}{dx}\left[e^u\right]=e^u\left(\frac{du}{dx}\right)$
$\frac{d}{dx}[uv]=u\frac{dv}{dx}+v\frac{du}{dx}$	$\frac{d}{dx}[\tan u]=\sec^2 u\left(\frac{du}{dx}\right)$
$\frac{d}{dx}\left[\frac{u}{v}\right]=\frac{v\frac{du}{dx}-u\frac{dv}{dx}}{v^2}$	$\frac{d}{dx}[\sec u]=\sec u\tan u\left(\frac{du}{dx}\right)$
Chain Rule: $\frac{dy}{dx}=\frac{dy}{du}\cdot\frac{du}{dx}$	Parametric Differentiation: $\frac{dy}{dx}=\left(\frac{dy}{dt}\Big/\frac{dx}{dt}\right)=\frac{dy}{dt}\cdot\frac{dt}{dx}$

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Table 2 : Integration

$\int a\,dx = ax + C$	$\int \sin nx\,dx = -\frac{1}{n}(\cos nx) + C$
$\int x^n\,dx = \frac{x^{n+1}}{n+1} + C, (n \neq -1)$	$\int \cos nx\,dx = \frac{1}{n}(\sin nx) + C$
$\int \frac{1}{nx+b}\,dx = \frac{1}{n}\ln\lvert nx+b\rvert + C$	$\int \tan x\,dx = \ln\lvert \sec x\rvert + C$
$\int \frac{1}{b-nx}\,dx = -\frac{1}{n}\ln\lvert b-nx\rvert + C$	$\int \sec^2 x\,dx = \tan x + C$
$\int e^{nx}\,dx = \frac{1}{n}\left(e^{nx}\right) + C$	$\int \csc^2 x\,dx = -\cot x + C$
Integration part by part: $\int u\,dv = uv - \int v\,du$	
Improper Integral: $\int_a^{\infty} f(x)dx = \lim_{b\to\infty}\int_a^b f(x)dx$	

Area of Region

$$A = \int_a^b [f(x) - g(x)]\,dx \quad \text{or} \quad A = \int_c^d [w(y) - v(y)]\,dy$$

Volume Cylindrical Shells

$$V = \int_a^b 2\pi x\, f(x)\,dx \quad \text{or} \quad V = \int_c^d 2\pi y\, f(y)\,dy$$

Arc Length

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

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Partial Fraction

$$\frac{a}{x^2-1}=\frac{A}{x+1}+\frac{B}{x-1}$$

Simpson's Rule

$$\int_a^b f(x)\,dx \approx \frac{h}{3}\left[(f_0+f_n)+4\sum_{\substack{i=1\\ i\text{ odd}}}^{n-1} f_i+2\sum_{\substack{i=2\\ i\text{ even}}}^{n-2} f_i\right]\;;\quad n=\frac{b-a}{h}$$

Trapezoidal Rule

$$\int_a^b f(x)\,dx \approx \frac{h}{2}\left[(f_0+f_n)+2\sum_{i=1}^{n-1} f_i\right]\;;\quad n=\frac{b-a}{h}$$