UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	ENGINEERING MATHEMATICS I
COURSE CODE	:	DAS 10203/ DSM 1923
PROGRAMME	:	1 DAA/DAM
EXAMINATION DATE	:	MARCH 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER ALL QUESTIONS IN **PART A** AND **THREE (3)** QUESTIONS IN **PART B**

THIS QUESTION PAPER CONSISTS OF EIGHT (8) PAGES

PART A

Q1 (a) Evaluate

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

(ii) $\int \left(e^{2x} + \cos \pi x\right) dx$.

(iii) $\int_1^4 \left(\sqrt{x} + \frac{1}{\sqrt{x}}\right) dx$.

(6 marks)

(b) Solve the following questions of integration.

(i) $\int \frac{x}{\sqrt{x+4}} dx$.

(ii) $\int 2xe^{2x} dx$

(iii) $\int x \ln x \, dx$

(iv) $\int \frac{3x+2}{x^2+3x+2} dx$

(12 marks)

(c) Find $\int_2^\infty \frac{dx}{(x-1)^2}$.

(2 marks)

Q2 (a) Find the area of the region enclosed by $y = 3 - x^2$ and $y = -x + 1$ between $x = 0$ and $x = 2$.

(7 marks)

(b) Use cylindrical shells method to find the volume of the solid that results when the region enclosed by $y^2 = 4x$, $x = 4$ and $y = 0$ is revolved about the $y-$axis.

(6 marks)

(c) Find the arc length of the curve $y = \frac{x^3}{12} + \frac{1}{x}$ from $x = 1$ to $x = 2$.

(7 marks)

PART B

Q3 (a) Given $p(x)=\begin{cases} x+6 & , x\le -2 \\ x^2 & , -2<x\le 3 \\ 5 & , x>3 \end{cases}$

(i) Sketch the function $p(x)$
(ii) Write the domain and range for function $p(x)$
(iii) Find the value of function $p(x)$ when $x=-3$, $x=2$ and $x=4$

(8 marks)

(b) If $q(x)=2-\dfrac{1}{x}$

(i) Find the inverse function of $q(x)$, $q^{-1}(x)$
(ii) Sketch the graph of $q^{-1}(x)$
(iii) Write the domain and range of $q^{-1}(x)$

(7 marks)

(c) Find the composite of $f\circ g\circ h$ if $f(x)=x-2$, $g(x)=3x+1$ and $h(x)=2x$

(5 marks)

Q4 (a) Evaluate the following limits.

(i) $\lim\limits_{t\to 2}\dfrac{3t^2-7t+2}{2-t}$

(ii) $\lim\limits_{x\to\infty}\sqrt{x^2+4}-x$

(7 marks)

(b) Let

$$f(x)=\begin{cases} 0 & \text{if } x\le -5 \\ \sqrt{25-x^2} & \text{if } -5<x<5 \\ 3x & \text{if } x\ge 5 \end{cases}$$

Compute the following limits or state that they do not exist.

(i) $\lim\limits_{x\to -5^-} f(x)$ (ii) $\lim\limits_{x\to -5^+} f(x)$ (iii) $\lim\limits_{x\to -5} f(x)$

(iv) $\lim\limits_{x\to 5^-} f(x)$ (v) $\lim\limits_{x\to 5^+} f(x)$ (vi) $\lim\limits_{x\to 5} f(x)$

(7 marks)

(c) Determine whether the function given are continuous at a.

$$g(x)=\begin{cases} \dfrac{x^2-1}{x-1} & \text{if } x\ne 1\ ;\quad a=1 \\ 3 & \text{if } x=1 \end{cases}$$

(6 marks)

Q5 (a) Find the derivative of the following expression

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

(ii) $y = \frac{1}{\sqrt{1-3x}}$

(iii) $y = 2x^3 e^{5x}$

(iv) $y = \ln(\sin^2 3x)$

(15 marks)

(b) Find the $\frac{dy}{dx}$ of the implicit equation of $4y^2 - 3x^2 = 2xy - 5$

(5 marks)

Q6 (a) Using L'Hôspital's Rule, find

(i) $\lim_{x \to 0} \frac{1 - \cos x}{x^2}$

(ii) $\lim_{x \to 1} \frac{x^2 + 12x - 13}{x - 1}$

(8 marks)

(b) Given a curve $f(x) = -x^5 + \frac{5}{2}x^4 + \frac{40}{3}x^3 + 5$.

(i) Find all the critical points.

(ii) Find f''.

(iii) Determine maximum and minimum points.

(iv) Find the inflection points, if exists.

(12 marks)

Q7 (a) The volume of a cube decrease at a rate of 500m/min. What is the rate of change of the side length when the side length are 12 meter?

(6 marks)

(b) Find the equation of tangent to the curve $y = (2x+3)^2$ when $x = 0$

(7 marks)

(c) By using Trapezoidal rule, find the value for $\int_1^4 \frac{1}{\sqrt{x}+3}dx$ by taking h = 0.5.

(7 marks)

- END OF QUESTION -

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Formulae

Trigonometric identity :

$$\cos^2\theta + \sin^2\theta = 1$$
$$1 + \tan^2\theta = \sec^2\theta$$
$$\cot^2\theta + 1 = \csc^2\theta$$

Differentiation :

$$\frac{d}{dx}[c] = 0$$

$$\frac{d}{dx}[x^n] = nx^{n-1}$$

$$\frac{d}{dx}[c\ f(x)] = c\frac{d}{dx}[f(x)]$$

$$\frac{d}{dx}[f(x) \pm g(x)] = \frac{d}{dx}[f(x)] \pm \frac{d}{dx}[g(x)]$$

$$\frac{d}{dx}[f(x)g(x)] = f(x)\cdot\frac{d}{dx}[g(x)] + g(x)\cdot\frac{d}{dx}[f(x)]$$

$$\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{g(x)\cdot\frac{d}{dx}[f(x)] - f(x)\cdot\frac{d}{dx}[g(x)]}{[g(x)]^2}$$

$$\frac{d}{dx}[\sin x] = \cos x$$

$$\frac{d}{dx}[\cos x] = -\sin x$$

$$\frac{d}{dx}[\tan x] = \sec^2 x$$

$$\frac{d}{dx}[\sec x] = \sec x \tan x$$

$$\frac{d}{dx}[\cot x] = -\csc^2 x$$

$$\frac{d}{dx}[\csc x] = -\csc x \cot x$$

$$\frac{d}{dx}[\sin^{-1} x] = \frac{1}{\sqrt{1-x^2}}$$

$$\frac{d}{dx}[\cos^{-1} x] = \frac{-1}{\sqrt{1-x^2}}$$

$$\frac{d}{dx}[\tan^{-1} x] = \frac{1}{1+x^2}$$

$$\frac{d}{dx}[\sec^{-1} x] = \frac{1}{|x|\sqrt{x^2-1}}$$

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Integration :

$\int c\, f(x)dx = c\,F(x) + C$

$\int \tan x\, dx = \ln|\sec x| + C$

$\int [f(x) \pm g(x)]\,dx = F(x) \pm G(x) + C$

$\int \sec^2 x\, dx = \tan x + C$

$\int x^r\, dx = \dfrac{x^{r+1}}{r+1} + C, (r \neq -1)$

$\int \csc^2 x\, dx = -\cot x + C$

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

$\int \sec x \tan x\, dx = \sec x + C$

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

$\int \csc x \cot x\, dx = -\csc x + C$

$\int \csc x\, dx = -\ln|\csc x + \cot x| + C$

$\int \sec x\, dx = \ln|\sec x + \tan x| + C$

Area of region :

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

Volume cylindrical shells :

$$V = \int_a^b 2\pi x\, f(x)\, dx$$

$$V = \int_c^d 2\pi y\, f(y)\, dy$$

Arc length :

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

Area of surface :

$S = \int_a^b 2\pi y \sqrt{1 + \left(\dfrac{dy}{dx}\right)^2}\, dx$ or $S = \int_c^d 2\pi x \sqrt{1 + \left(\dfrac{dx}{dy}\right)^2}\, dy$

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

Improper integral :

$$\int_a^{+\infty} f(x)\,dx = \lim_{C\to+\infty}\int_a^C f(x)\,dx$$

$$\int_{-\infty}^{b} f(x)\,dx = \lim_{G\to-\infty}\int_G^b f(x)\,dx$$

$$\int_{-\infty}^{+\infty} f(x)\,dx = \int_{-\infty}^{K} f(x)\,dx + \int_K^{+\infty} f(x)\,dx$$

$$\int_a^b f(x)\,dx = \lim_{P\to b^-}\int_a^P f(x)\,dx$$

$$\int_a^b f(x)\,dx = \lim_{H\to a^+}\int_H^b f(x)\,dx$$

$$\int_a^b f(x)\,dx = \int_a^c f(x)\,dx + \int_c^b f(x)\,dx$$