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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	ENGINEERING MATHEMATICS I
COURSE CODE	:	DAS 10203
PROGRAMME	:	1 DAA / 1 DAM
EXAMINATION DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	A) ANSWER **ALL** QUESTIONS IN SECTION A B) ANSWER **THREE (3)** QUESTIONS ONLY IN SECTION B

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

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SECTION A

Q1 (a) Evaluate

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

(ii) $\int_1^4\left(\frac{x^2+\sqrt{x}}{x^2}\right)dx$

(7 marks)

(b) By using substitution technique, evaluate $\int\left(2x\sqrt{x^2+x}+\sqrt{x^2+x}\right)dx$.

(4 marks)

(c) Solve $\int\left(3x^2\sin x\right)dx$ by using appropriate technique.

(4 marks)

(d) By using trapezoidal technique, find $\int_1^3\left(\frac{x^2}{\sqrt{x+1}}\right)dx$ by taking $n=8$.

(5 marks)

Q2 (a) Find the area of the region bounded above by $y=-x+12$, bounded below by $y=x^2$, and bounded on the sides by the lines $x=-4$ and $x=3$.

(10 marks)

(b) Find the volume of the solid generated by revolving the region bounded by $y=\sqrt{2x}$, between $x=1$ and $x=3$ about the y - axis.

(10 marks)

SECTION B

Q3 (a) Sketch the graph and determine the domain and range.

(i) $y = 3x^2 + x - 5$

(ii) $y = -\dfrac{1}{(x-4)}$

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

(iv) $y = \sqrt{-x-5}$

(12 marks)

(b) Given $f(x) = \sqrt{x}$, $g(x) = \dfrac{3x^2}{2} - 2$ and $h(x) = x - 4$. Calculate

(i) $f \circ g$

(ii) f^{-1}

(iii) $f^{-1} \circ g \circ h^{-1}$

(8 marks)

Q4 (a) Compute the limit

(i) $\lim\limits_{x \to \infty} \left(\sqrt{x+1} + \sqrt{x}\right)$

(ii) $\lim\limits_{x \to a} \dfrac{(x-a)^3}{x^2 - a^2}$

(iii) $\lim\limits_{x \to \infty} \dfrac{3x^3 + 2x}{2x^2 + 5x + 3}$

(iv) $\lim\limits_{x \to 2} \dfrac{x-2}{3 - \sqrt{2x+5}}$

(12 marks)

(b) Given $g(x) = \begin{cases} x^2 - 4x + 2, & x \le 2 \\ 0 & , x > 2 \end{cases}$

(i) Find $g(2)$.

(ii) Evaluate $\lim\limits_{x \to 2} g(x)$.

(iii) Determine whether $g(x)$ is continuous at $x = 2$.

(8 marks)

Q5 (a) Find the derivative of the following expression

(i) $x^2 + 2xy + 3y^2 = 1$

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

(7 marks)

(b) Given $\sin y = u$ where $u = 2x^2 - 1$, find $\frac{dy}{dx}$ in term of x.

(5 marks)

(c) If $y = ax^2 + \frac{b}{x}$

(i) show that $x^2 \frac{d^2y}{dx^2} = 2y$.

(ii) find the values of a and b if $y = 2$ and $\frac{dy}{dx} = 3$ when $x = 1$.

(8 marks)

Q6 (a) Using L'Hôspital's Rule, find

(i) $\lim_{x \to 0} \frac{8x^2}{\cos x - 1}$

(ii) $\lim_{x \to \infty} \frac{5x^2 - 3x}{7x^2 + 1}$

(6 marks)

(b) If the displacement of a particle is given by the formula $s = 3t^3 - 20t^2 + 40t$ find

(i) the displacement after 3 seconds.

(ii) the formula for the velocity at any time t.

(iii) the values of t when the particle is not moving.

(iv) the initial velocity of the particle.

(v) the formula for the acceleration at any time t.

(vi) the initial acceleration of the particle.

(14 marks)

Q7 (a) Find $\int \frac{3x+1}{x^2+4x+3}\,dx$ using partial fraction method.

(8 marks)

(b) Sketch the graph of $y = x^3 - 9x^2 + 24x - 7$. Plot any stationary points and any points of inflection.

(12 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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Formulae

Integration :

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

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

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

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

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

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

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

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

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

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

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

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

$$\int \frac{dx}{x} = \ln|x| + C, (r \neq -1)$$

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

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 :

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

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

Arc length :

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

Area of surface :

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

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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 :

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

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

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

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

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

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