Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER I
SESSION 2020/2021

COURSE NAME	:	ENGINEERING MATHEMATICS I
COURSE CODE	:	DAC 11203
PROGRAMME CODE	:	DAA
EXAMINATION DATE	:	DECEMBER 2020 / JANUARY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS.

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THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) Region R is bounded by curve $y = 2x^2 + 10$ and $y = 4x + 16$ that intersect at point P and Q.

(i) Determine points P and Q.

(4 marks)

(ii) Find the area of region R

(5 marks)

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

(5 marks)

(c) Solve for $\int_1^\infty \frac{1}{x^2}\,dx$.

(4 marks)

(d) By using Trapezoidal rule, solve the following integral by taking step $h = 0.5$ with three decimal places

$$y = \int_2^5 \frac{e^x}{\sqrt[3]{x^2 + 2}}\,dx$$

(7 marks)

Q2 a) (i) Find the derivative for $8y^2 - x^4 = 6$ using implicit differentiation.

(3 marks)

(ii) Solve by parametric differentiation for the following equations when $t = 2$:

$$x = 3t - 4\sin t \text{ and } y = t^2 + t\cos \pi t.$$

(7 marks)

b) (i) Identify and locate the local extreme and inflection points of the following function. Hence, sketch the graph.

$$y = 4x^4 - 8x^3.$$

(12 marks)

(ii) Calculate the following limits by using L'Hospital's Rule:

$$\lim_{x \to 2} \frac{x^2 + 2x - 8}{2x^2 - 3x - 2}.$$

(3 marks)

Q3 (a) (i) Define piecewise function and give **ONE (1)** example.

(4 marks)

(ii) Give **ONE (1)** application in real life that can relate to piecewise function.

(2 marks)

(b) Sketch the graph of

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

(4 marks)

(ii) $y = 6 - x.$

(3 marks)

(iii) $y = \frac{1}{x+1} - 4.$

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(4 marks)

(c) Based on your answer in Q3 (b), sketch the graph of

$$f(x)=\begin{cases} 6-x & , \quad x\geq 2 \\ 2x^2-4 & , \quad -1\leq x<2. \\ \dfrac{1}{x+1}-4 & , \quad x<-1 \end{cases}$$

(6 marks)

(d) State the domain and range based on your answer in **Q3(c)**.

(2 marks)

Q4 Let

$$f(x)=\begin{cases} 5x-3a \text{ if } -5<x<0 \\ 3x^2-6 \text{ if } 0\leq x<2 \\ x+4 \text{ if } 2\leq x\leq 5 \end{cases}$$

(a) Evaluate each limit, if it exists:

(i) $\lim_{x\to 0^-} f(x)$.

(2 marks)

(ii) $\lim_{x\to 0^+} f(x)$.

(2 marks)

(iii) $\lim_{x\to 2^-} f(x)$.

(2 marks)

(iv) $\lim_{x\to 2^+} f(x)$.

(2 marks)

(b) Find the value of a in which $f(x)$ is continuous at $x=0$.

(2 marks)

(c) Sketch the graph of $f(x)$.

(6 marks)

(d) Evaluate the following limits:

(i) $\lim_{x\to 1}\dfrac{x^2-1}{x-1}$.

(3 marks)

(ii) $\lim_{x\to 0}\dfrac{\sqrt{x+1}-1}{x}$.

(3 marks)

(iii) $\lim_{x\to 9}\left(\dfrac{x-9}{\sqrt{x}-3}\right)-1$.

(3 marks)

-END OF QUESTIONS -

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Table 1: Partial Fraction

$\dfrac{a}{(s+b)(s-c)} = \dfrac{A}{s+b} + \dfrac{B}{s-c}$
$\dfrac{a}{s(s-b)(s-c)} = \dfrac{A}{s} + \dfrac{B}{s-b} + \dfrac{C}{s-c}$
$\dfrac{a}{(s+b)^2} = \dfrac{A}{s+b} + \dfrac{B}{(s+b)^2}$
$\dfrac{a}{(s+b)(s^2+c)} = \dfrac{A}{(s+b)} + \dfrac{Bs+C}{(s^2+c)}$

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Table 2: Integration and Differentiation

Integration	Differentiation
$\int x^n dx = \frac{x^{n+1}}{n+1} + C$	$\frac{d}{dx} x^n = nx^{n-1}$
$\int \frac{1}{x} dx = \ln\|x\| + C$	$\frac{d}{dx} \ln x = \frac{1}{x}$
$\int \frac{1}{a-bx} dx = -\frac{1}{b} \ln\|a-bx\| + C$	$\frac{d}{dx} \ln(ax+b) = \frac{a}{ax+b}$
$\int e^{ax} dx = \frac{1}{a} e^{ax} + C$	$\frac{d}{dx} e^{ax} = ae^{ax} n$
$\int \sin ax \, dx = -\frac{1}{a} \cos ax + C$	$\frac{d}{dx} \sin ax = a \cos ax$
$\int \cos ax \, dx = \frac{1}{a} \sin ax + C$	$\frac{d}{dx} \cos ax = -a \sin ax$
$\int \sec^2 x \, dx = \tan x + C$	$\frac{d}{dx} \tan x = \sec^2 x$
$\int \csc^2 x \, dx = -\cot x + C$	$\frac{d}{dx} \cot x = -\csc^2 x$
$\int u \, dv = uv - \int v du$	$\frac{d}{ds}(uv) = u\frac{dv}{ds} + v\frac{du}{ds}$
$\int_a^b f(x) dx = F(b) - F(a)$	$\frac{d}{ds}\left(\frac{u}{v}\right) = \frac{v\frac{du}{ds} - u\frac{dv}{ds}}{v^2}$

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Area of Region

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

Volume Cylindrical Shells

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

Arc Length

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

Simpson's Rule

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

Trapezoidal Rule

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