Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	ENGINEERING MATHEMATICS I
COURSE CODE	:	DAC 11203
PROGRAMME CODE	:	DAA
EXAMINATION DATE	:	JANUARY/ FEBRUARY 2022
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS.
		2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK.**

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) Solve $\int \frac{x^3}{x^2-2x+1}dx$ by using partial fraction.

(7 marks)

(b) Evaluate $\int_2^7 \frac{1}{e^x-2^x}dx$ by using Simpson's rule. Write your answer in three decimal places with $h=0.625$.

(5 marks)

(c) Given two curves $y=\sqrt{4x}$ and $y=\frac{1}{2}x$.

(i) Find the area of the region enclosed by these two curves.

(8 marks)

(ii) Determine the volume of the solid generated when the region enclosed between these two curves is revolved about the $x-$axis.

(5 marks)

Q2 (a) Differentiate $y=\frac{e^{6x}}{\sin(8x+5)}$.

(5 marks)

(b) Given $y=4\sin t+2e^{-5t}$ and $x=25t^4-\cos t$. Find $\frac{dy}{dx}$ by using the parametric differentiation.

(4 marks)

(c) By using implicit differentiation, find $\frac{dy}{dx}$ if

$$x^2+x^3y^3-2\ln(1+3y)=2y+3.$$

(6 marks)

(d) Find the critical points, inflection points, maximum and minimum points for $y=x^3-9x^2+24x-2$. Then, sketch the graph.

(10 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) $y = 4x^2 - 8.$

(4 marks)

(ii) $y = 3 - x.$

(3 marks)

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

(4 marks)

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

$$f(x) = \begin{cases} 3-x & , \quad x \geq 2 \\ 4x^2 - 8 & , \quad -1 \leq x < 2. \\ \frac{1}{x+1} - 4 & , \quad x < -1 \end{cases}$$

(6 marks)

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

(2 marks)

Q4 Let

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

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

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Area of Region

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

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

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

Trapezoidal Rule

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